

A CRITICAL RATIONALIST APPROACH TO ORGANIZATIONAL LEARNING: TESTING THE THEORIES HELD BY MANAGERS

Doron Faran¹

Department of industrial Engineering and Management, Ort Braude Academic
College of Engineering, Karmiel, Israel (dfaran@braude.ac.il)

Fons Wijnhoven

School of Management and Governance, University of Twente, Enschede, The
Netherlands (a.b.j.m.wijnhoven@utwente.nl)

Abstract: The common wisdom is that Popper's critical rationalism, a method aimed at knowledge validation through falsification of theories, is inadequate for managers in organizations. This study falsifies this argument in three phases: first, it specifies the obstructers that prevent the method from being employed; second, the critical rationalist method is adapted for strategic management purposes; last, the method and the hypotheses are tested via action research. Conclusions are that once the obstructers are omitted the method is applicable and effective.

Keywords: Organizational learning, Epistemology, Theory-of-action, Critical rationalism, Action research

1 INTRODUCTION

In a previous paper, presented at OLKC 2010², we targeted the confrontation of the managerial unawareness problem. Assuming that any decision-maker acts upon a theory he or she has of the world, the unawareness problem is defined as a state in which this theory is false whilst the theory holder does not imagine the very possibility of that falsehood. The consequences, so we argued, have a great hazardous potential since the entire decision-making process rests upon a tenuous basis.

Yet the problem is paid a marginal attention in the management literature (compared to other decision-making problems, e.g. ambiguity or uncertainty), mainly from a cognitive perspective that explains why the "true" theory is ignored. We argued that once a different perspective is employed, namely the epistemological one, we can lean upon a large body of knowledge from the philosophy-of-science field. In this sense the philosopher Karl Popper was distinguished as purposively addressing the exact notion of unawareness through Critical Rationalism (CR). In brief, Popper (1961) sees no prospect in enhancing the *discovery* abilities that sustain the theory formation; instead he focuses on the phase of *justification*, in which the theory is tested. By applying logical vehicles for testing, Popper claims, I can avoid the cognitive trap whatsoever and construct a much more objective and instructible method.

The method respects three principles: falsification, deduction and active criticism. The principle of falsification stands against the notion of verification by claiming that a theory can only be falsified but can never be verified, so a theory is nothing but tentative. The principle of

¹ The corresponding author: Dr. Doron Faran, Department of industrial Engineering and Management, Ort Braude Academic College of Engineering, POB 78, Karmiel 21982, Israel; Phone: +972-4-9901824; fax: +972-4-9522499; e-mail: (dfaran@braude.ac.il).

² Titled: "Organizational learning, epistemology and theory justification: the absence of the major premise", and available at OLKC 2010 website. The following lines are a very succinct summary of that paper, and for those who are interested in the topic we strongly recommend reading the full version.

deduction provides the procedure of falsification: from the (unverifiable) theory an event is deduced that the theory prohibits, and if the event is contradicted in reality the theory is falsified. The principle of active criticism is about the active quest for falsification, i.e. that the scientist should expose the theory to as tough as possible tests in order to detect problems. The activeness and the deductive logic counteract the cognitive unawareness.

Given these qualities and the equivalent need, can the CR method serve the management discipline against unawareness? The common wisdom provides a negative answer. We aggregated the various (but consistent) objections under what we have titled the *Inadequacy Argument*. In summary, the Argument is twofold:

1. The strategic environment that surrounds the organization does not lend itself to theorization in the notion implied by CR because every constellation is unique, thus one cannot speak of "universal laws" to be falsified.
2. The organization cannot test its theories about the environment without influencing that environment, thus the test is "contaminated".

We challenge the *Inadequacy Argument*. Based on seminal organizational learning traditions we constructed the *Falsification Obstructors* theory (Figure 1), that holds the following rationale:

1. Unknowingly, the organization exhibits several fragments of CR among its regular learning processes. Over all, it is possible to present the organizational "theoretical system" in a Popperian-like structure.
2. These fragments assemble around two routes of derivation: the left-hand side constitutes the organizational design theory, whilst the right-hand side exhibits the organization's predictions of the environment (scenarios).
3. The unawareness, if exists, resides in the *Descriptive theory*; hence this theory is the one to be tested.
4. Of the two routes, the *Inadequacy Argument* applies only to the left. *No attempt has been made to utilize the right route in CR manner*.

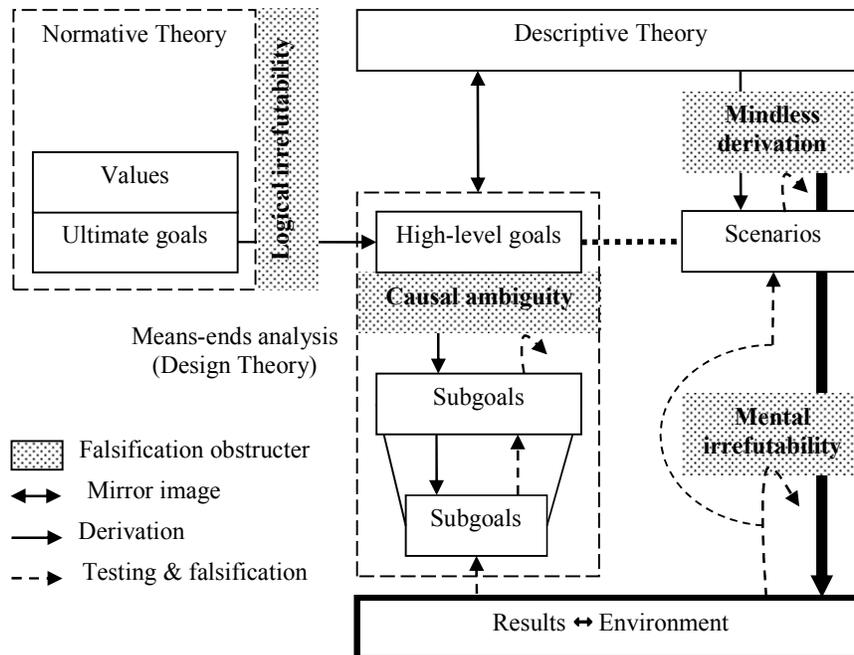


Figure 1. The organization's "Theoretical System"

The aims of this research are (1) to corroborate the *Falsification Obstructors* theory and by that to supplant the *Inadequacy Argument*; we will assume corroboration if the removal of the *falsification obstructers* will enable falsification via the Popperian doctrine (counter to the *Inadequacy Argument*). (2) To counteract the unawareness problem.

2 THE RESEARCH DESIGN

Toward the aims just mentioned we have to design a method that removes the falsification obstructers, apply it in real organizational setting and evaluate the impact. The double aim of developing an instrument that simultaneously tests a theory *and* solves a problem merges two scientific activities – explanation and design – into one discipline known as *design science* (March & Smith, 1995).

2.1 The Design-Science Framework

Walls et al (1992) provide a research framework ("design theory") that manifests the double meaning of "design": for one as a product, for two as a process. The framework is exhibited in Figure 2.

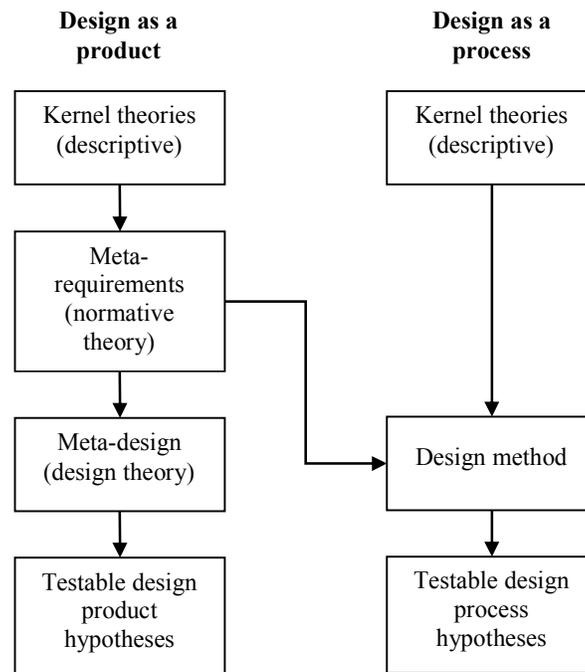


Figure 2. Components of Design Theory (source: Walls et al, 1992)

The product's components are defined as follows:

The first component of a design theory dealing with the product of design is a set of *meta-requirements* which describe the class of goals to which the theory applies. We use the term "meta-requirements" rather than simply requirements because a design theory does not address a single problem but a class of problems. The second component is a *meta-design* describing a class of artifacts hypothesized to meet the meta-requirements. We use "meta-design" because a design theory does not address the design of a specific artifact (e.g., a payroll system for XYZ corporation) but a class of artifacts (e.g., all transaction processing systems). The third component is a set of *kernel theo-*

ries from natural or social sciences which govern design requirements. The final component is a set of *testable design process hypotheses* which can be used to verify whether the meta-design satisfies the meta-requirements (Walls et al, 1992, pp. 42-43; italics in origin).

And the process' components read:

The second aspect of a design theory deals with the design process. The first component of this aspect is a *design method* which describes procedure(s) for artifact construction. The second is a set of *kernel theories* from the natural or social sciences governing the design process itself. These kernel theories may be different from those associated with the design product. The final component is a set of testable *design process hypotheses* which can be used to verify whether or not the design method results in an artifact which is consistent with the meta-design (Walls et al, 1992, p. 43; italics in origin).

2.2 The Framework's Instantiation in the Research

The product is the Popperian method adapted for organizations, and the adaptation constitutes the process. The design components are detailed in Table 1. Note that the hypotheses (highlighted by italics) encounter both pillars included in the *Inadequacy Argument*, i.e. the environment and the organization (H1 and H2, respectively).

Table 1. The Design Theory components as instantiated in the research

Component	Design as a product	Design as a Process
Kernel theories	Popper's Critical Rationalism doctrine.	The organization theories (means-ends, theory-of-action, SID, organizational learning) that underlie the <i>falsification obstructers</i> theory.
Meta-requirements	Exclusive justification, deduction-based falsification, insensitivity to psychologism, unequivocal and testable criteria for problem recognition.	Not applicable.
Meta-design/ Design method	Syllogistic structure in which the descriptive Theory stands for the major premise and the right route (scenarios) provides the minor premise, the prediction and the conclusion.	Crafting an assortment of techniques that confront the obstructers along the selected route.
Testable design/process hypotheses	<i>H1a.</i> The organization's environment can be ³ theorized in a falsifiable fashion. <i>H1b.</i> The right route is capable of obtaining unequivocal	<i>H2.</i> The techniques employed throughout the method overcome the "mindless derivation" and the "mental irrefutability" falsification obstructers.

³ "Can be" is a verifiable form; once verified it falsifies a universal form that prohibits such an instance. In our case the *Inadequacy Argument* excludes this "can be" hypothesis.

Component	Design as a product	Design as a Process
	falsification.	

2.3 The Research Method

The integrated design-explanation objectives pose two major constraints to the research method:

1. The hypotheses testing entail an experiment in which the independent variables (the obstrucers) are manipulated; so the method should be experimental.
2. The variables are complicated and multifaceted.

In order to meet these constraints the Action Research (AR) method was selected. The AR is definitely an experimental method (Hatchuel, 2005) which is explicitly recommended for methodological innovation purposes (Baskerville & Wood-Harper, 1996). The AR eliminates the weakness of laboratory experiments that are limited to simple, isolable variables (Mitroff & Mason, 1981), therefore is proper for investigating complex social systems (Argyris, Putnam & Smith, 1985).

AR is a genre rather than a monolithic method (Baskerville & Wood-Harper, 1998). Historically, the method emerged in the 1940's within the social sciences (sociology and psychology). It emphasized the active participation and involvement of the researched objects, in particular those who have been previously excluded (Baskerville & Wood-Harper, 1998; Kemmis & McTaggart, 2000); therefore the method is associated with emancipation (Wadsworth, 1998). Later it became popular in the field of education and nowadays also in information systems development (e.g. Lindgren, Henfridsson & Schultze, 2004) and management (e.g. French, 2009/a). Over the time the method has diversified along several streams, including "the action research stream that focuses on changing practice, the action science stream for conflict resolution, the participatory action research stream for participant collaboration, or the action learning stream through experiential learning" (Lau, 1999, p. 162); our research affiliates to the first, i.e. "plain" action research.

Basically the AR consists of two phases: diagnosis and change (Baskerville & Wood-Harper, 1998). The Canonical Action Research (CAR) model (Susman & Evered, 1978), which is shared across many AR variations, is expanded up to five phases (Figure 3). The leading idea is the iterative cycle around a client-system infrastructure, defined as "the social system in which the members face problems to be solved by action research" (Susman & Evered, 1978, p. 588).

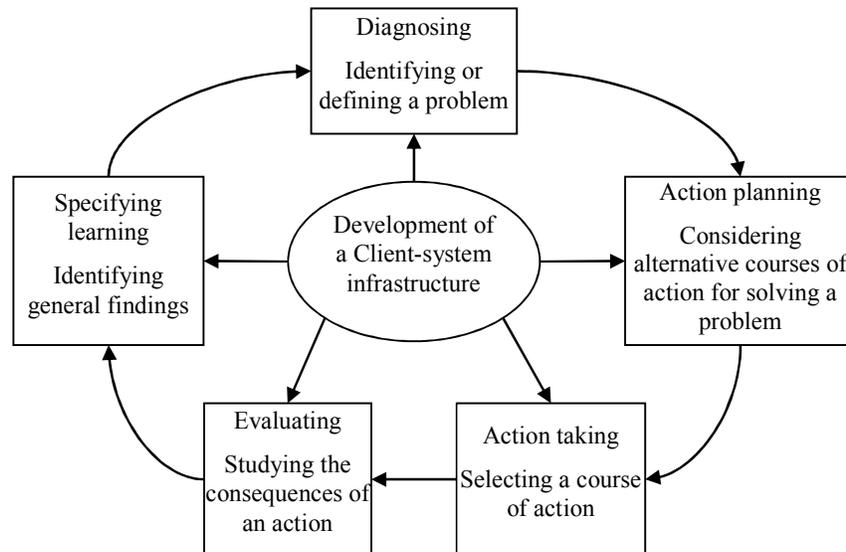


Figure 3. The cyclical process of canonical action research (source: Susman & Evered, 1978, p. 588)

The AR is applicable for both design science (Järvinen, 2005) and the CR approach (Cunha & Figueiredo, 2002).

2.4 Detailed Research Design by Phases

Overview: the span of the research has to balance the tension between two considerations. On the one hand, the AR method is time-consuming and costly, all the more so when strategic consequences are expected. On the other hand, a narrow study faces the risk of over-singularity. In order to compromise both conflicting constraints the AR is planned to encompass three organizations in two cycles: two organizations in the first cycle, one organization in the second cycle.

Diagnosis: the aims are to realize the "Theoretical System" (Figure 1), to frame the assumed obstructers and to characterize the *Descriptive Theory* in that system (the testing target). Data will be collected through one-on-one, in-depth and semi-structured interviews with a small but representative sample of decision-makers. Respondents will be asked, sometimes vicariously, what the theory that guides their decisions is, and how they warrant the truth of those theories. The data collected through the interviews is dissected to utterances and arranged in alignment with the "Theoretical System".

Action planning: this phase materializes the method's design and builds on the framework provided by March & Smith (1995). Like Walls et al (1992), March & Smith divide the design into product and process. The combination forms the matrix presented in Table 2. The phase actualizes the first three components of the *Build* activity.

Table 2. A Design Science research framework (edited from: March & Smith, 1995, p. 255)

Research activities (process)			
Design science		Explanatory science (hypotheses testing)	
Build	Evaluate	Theorize	Justify

Research outputs (product)	Construct				
	Model				
	Method				
	Instantiation				

Action taking: in this phase the method is instantiated, in line with the fourth *Build* activity. This phase is expected to be the longest of the research, since strategic changes in the environment that may refute the Descriptive theory usually take time.

Evaluating: Table 3 presents the applicable evaluation criteria, based on March & Smith (1995).

Table 3. Criteria for evaluation (based on: March & Smith, 1995, p. 261)

Design product	Evaluation criteria
Construct	Completeness, simplicity, understandability, and ease of use.
Model	Validity, as the result of internal consistency <i>and</i> fidelity with real world phenomena.
Method	Operationality (the ability of humans to effectively use the method), efficiency, generality, and ease of use.
Instantiation	Efficiency and effectiveness of the artifact and its impacts on the environment and its users.

Specifying learning: in this phase we materialize the hypotheses testing. The "Theorize" and "Justify" activities that constitute this phase read:

Discover, or more appropriately for IT research, theorize, refers to the construction of theories that explain how or why something happens. In the case of IT research this is primarily an explanation of how or why an artifact works within its environment. Justify refers to theory proving. It requires the gathering of scientific evidence that supports or refutes the theory (March & Smith, 1995, p. 258).

3 THE FIRST CYCLE: DIAGNOSIS

3.1 The Participants

The 1st cycle involved two participants, varied by their motivation to engage and by their characteristics. Hereinafter they are identified as IND and EDU. The research was conducted at both simultaneously while each is unbeknown to the other, being the researcher the sole linking connector. The period in point is 2002-2006, and the following details are updated as of the research's outset.

IND is an Israeli medium high-tech manufacturer of video streaming equipment. The company is vertically integrated along its product line, from R&D through production to worldwide marketing and sales. Horizontally, however, the company largely depends on the environment since its products should be integrated in complex systems beyond the company's control. The company consisted of headquarter (HQ) and two SBUs: one engaged in TV broadcasting over telephone wires and the other in video encoding (all the three units participated). Short before

the research the dot-com bubble had exploded, driving the environment into extreme turbulence during the research.

IND joined a research project funded by the European Commission, aimed at studying and developing knowledge management practices in small and medium enterprises. The research was part of this project, so the official project contract covered the researcher-client agreement. It so happened that the research started a few months after the company had crafted its strategy, and this accidental proximity made the investigation relevant and vivid.

EDU is an Israeli academic college of engineering. It is a public NGO, budgeted by the national Council for Higher Education (CHE). EDU maintains five programs toward an engineering degree, each in a department: mechanical engineering, electronics, bio-technology, software and industrial engineering.

A brief background: up to the 1990s the higher education system in Israel consisted of seven research universities, all in big cities. Since demand for academic education has outnumbered the supply, the universities could be selective; consequently academic degree remained exclusive, associated with high socio-economic status. The government encountered massive pressure to enhance social mobility through education, meaning more universities; alas, universities are costly. The CHE adopted another idea: to establish colleges, dedicated solely for teaching first degrees (i.e. no research); it was assumed a much cheaper alternative. In order to attain another social objective, to boost the periphery, most colleges ought to be located in small and distant towns. EDU, among other, was the outcome of this policy: an academic school of engineering in northern Israel. At the same time several private colleges were also licensed, all in central areas (and with much higher tuition). Consequently, the education supply has increased significantly in a very short time. The instant increase introduced all the academic institutions in Israel (including universities) to an unfamiliar playground: market competition.

For long, public academic institutions around the world have not been associated with competitive thinking; it was strange to the "ivory tower" image. However, major social changes did affect the academia (Brown & Duguid, 2000), and business practices – competitive strategy included – made their way into the board room (e.g. Morrison & Mecca, 1989). Nevertheless the strategic thinking idea remained unfamiliar with EDU, and when the newly-arrived president acknowledged the need for formal strategy he asked for advice. One author proposed to integrate the research within the strategic process, and the president – acquainted with academic research, to be sure – accepted. That was the platform on which the researcher-client agreement was established.

Strategy is regarded confidential; the participants were explicitly aware of the publicity this research would receive, and agreed. Anyway, the lasting of the research made the content outdated and competitively valueless.

Table 4. "ID card" of the 1st cycle's participants

Alias	IND	EDU
Identity	High-tech manufacturer	Academic college
Industry	Video streaming	Higher education
Ownership	Public enterprise	Budgeted NGO
Size (number of employees)	150	250
Structure	Headquarter, two SBUs	President, five faculties, administration
Range of activities	Vertically integrated: from R&D	Pre-academic studies, 1 st four-year

3.2 Diagnosis⁴

IND

The Theory: the Descriptive theory comprises three types of statements. The first discloses the conceptual structure; for instance, subcategories in the customers' market: "The market consists of the Telco's and the cables companies". The second reflects the concept attainment, i.e. attribution (Bruner et al, 1956): "Video is a psychological need". The third relates the concepts by causality: "The product's decline is influenced by both customers and new technology".

Problems: the data indicates three problems: mindless derivation, mental irrefutability and causal ambiguity. The fourth problem suggested in the model, i.e. logical irrefutability, is insignificant due to the marginality of the Normative theory. The marginality is clearly exclaimed in the statement: "The goals are mainly market-driven, this is the leading factor", followed by defining values as nonsense and a waste of time.

Accordingly, the most extensive influence is of the scenarios on the high-level goals. Process examples are: "What are the competitors doing and which share of the market each is taking? This will determine my choice"; or: "First we look at the market and try to understand its trends, and then we look inside and check what we can offer". A content example: "Any change in these trends [MPEG, HDTV] will be critical for us. We still don't know whether to enter the market or not".

Below we discuss the three discernible problems.

Mindless derivation: The prime indication of mindlessness is the unawareness of the very existence of scenarios. Although scenarios are exercised in practice, the "espoused theory" is in denial: "We didn't use scenarios during the strategic thinking", and "I definitely would not consider the method of scenarios".

Another sign of mindlessness is *fragmented scenarios*. Table 5 exhibits IND's "consistency measure": the extent to which the concepts reappear along the right falsification route. On face value the scenarios' derivation is consistent with the Descriptive theory; but the picture is misleading. Almost each driving force generates a stand-alone scenario, isolated from the others. Consider for example the following two dimensions:

- The "standards" dimension, by which two scenarios emerge: the triumph of either MPEG or Microsoft.
- The "customers" dimension, with two scenarios: "The Telco's crisis posits two alternative courses: one is that they will go bankrupt and be nationalized, the other that they will be forced to find new revenues"; therefore –

"The balance between the Telco's and the cables is critical for our strategy".

However, no scenario integrates these dimensions (or any of the others) coherently, although they all shape a unified reality.

Table 5. IND's "consistency measure"

⁴ The limited length of this paper prevents the demonstration of the plentiful raw data. The interested readers are welcomed to contact the corresponding author (see footnote 1).

Concepts	Descriptive Theory	Initial conditions	Scenarios	Environment
Market players/Competitors	+	+	+	+
Market/Trends/Market size	+	+	+	+
Product price	+		+	
Customers	+	+	+	+
Demand	+	+	+	+
Technology	+	+	+	+
Products	+	+	+	+
Technological standards	+	+	+	+
Regulation	+	+		
Infrastructure/Value chain	+	+		+
Society & Economy	+			

Mental irrefutability: four facets are detected. One is the commitment to previous predictions, exemplified by the following episode: the firm counted on a five-year forecast, which after three years was proved incorrect. Rather than rechecking the underlying theory –

We have tried to reconstruct a rule that would explain what had happened to the market. I assume that "business is as usual", that the forecast should have been correct hadn't these nonlinear events occurred. Let's exercise the equation that will reflect them and get the actual reality. I guess that the backward correction applies forward as well.

The second facet is the availability bias, indicated by three instances. First, the relevance is taken for granted; when asked about his first-priority knowledge gap, the interviewee answered: "What are the interdependencies among the forces that are relevant for me". Second, each issue is watched by a dedicated taskforce. Third, the environmental feedback relies heavily on current customers, whose perspective is aligned with that of IND in the first place (Christensen, 1997/b).

The third facet represents the *self-sealing* phenomenon (Argyris, 1976/a): the environmental scanning is subordinated to the production capacity. During the aforementioned conversation the interviewee declared: "I will ask about HDTV half a year before I'm planning to develop the product". A colleague commented: "this schedule is right for you, but the market may dictate a different schedule", to that the interviewee answered: "may be, but I won't decide earlier anyway".

The fourth facet is low esteem of the testing capability; when asked about an attribute contained in the Theory (that the market is price-sensitive), the interviewee answered: "We assume that the same attribute will hold in the future. I don't have any way to check it but retroactively".

Causal ambiguity: clearly the results – especially the market's response to the company's products – are the most essential (even if late) measure: "The best indicator, although too late, is how the product is accepted in the market". However, the meaning of the results is ambiguous (like the control framework suggests): "We are not alone in the market, so if our product is declined the reason may be that a competitor offered a better or a cheaper product". The ambiguity prevails in the other way around as well: "the distance between understanding the market and transforming this understanding to a product is still long". Likewise the strategy officer testified that only after he knew the results he would try to understand what in the strategy had caused them.

Another indicator for causal ambiguity concerns the information collection from the customers. The interviewees pictured a confused dialogue in which both sides guess what the market's signals mean.

Diagnosis confirmation: the diagnosis was confirmed by a panel assembled of the interviewees (except one) and additional staff officers.

EDU

The Theory: the descriptive Theory comprises the same three types of statements as in IND. The first discloses the conceptual structure; for instance, "The academic competitive arena is divided to three leagues: universities, national colleges, and regional colleges". The second reflects the concept attainment, i.e. attribution: "Engineering means quantification". The third relates the concepts by causality: "More students bring more resources".

Problems: the prominent problems in EDU are the logical irrefutability (which literally "goes without saying") and the mindless derivation. The former reflects the remarkable influence that the normative Theory has on the means-ends construct; we do not address this problem. The mindless derivation is apparent upon the "consistency measure" (Table 6): the vast majority of the Theory's concepts are omitted from the initial conditions or the scenarios. Both Theory and scenarios exist, but disconnected.

The *mental irrefutability* obstructor is neutralized since no attempts at refutation were exercised. The *causal ambiguity* obstructor was not detected; to the contrary, the interviewees were confident about how to attain their goals. Two factors propel this confidence: first, the sound normative theory stands as a guideline; second, the reliance on self-experience. For example, one interviewee justified her design Theory on her and her children's experience basis.

Table 6. EDU's "consistency measure"

Concepts	Descriptive Theory	Initial conditions	Scenarios	Environment
Competition/Universities/Colleges	+	+	+	+
Academic leagues	+			
[Other] education providers	+			
Attractiveness/ Prestige/ Reputation/ Diploma/Market's evaluation/Added value	+			
Budget/Resources/Staff positions	+			

Concepts	Descriptive Theory	Initial conditions	Scenarios	Environment
Engineering/Engineers/Graduates	+		+	+
Professional knowledge	+		+	+
Change rate				+
Learning abilities	+			
Demand for education/Labor market/ Society ("the street")	+			+
Students/ Students' level/ Students' expectations & preferences	+			+
Faculty members/Academic challenge	+			
Scientific breakthroughs	+			
Teaching styles/Teachers-students relations/ Educational telecommunication	+		+	+
Information			+	+

Diagnosis confirmation: the diagnosis was confirmed by the expanded strategy forum that included the senior and the mid management; all the interviewees attended.

4 ACTION PLANNING

As noted earlier, only the left falsification route (Figure 1) is assumed to be subject to the *Inadequacy Argument*; therefore the intervention targets the right hand-side route, i.e. the scenarios. The following structure reflects Table 2.

4.1 Constructs

The scenarios' derivation flow constitutes a syllogism, so the first three of the following constructs present a syllogistic structure: the Descriptive theory as the major premise, the initial conditions as the minor premise and the scenarios as the conclusion. The last construct ("Environment") stands for the *basic statement* that is compared against the conclusion.

4.1.1 Descriptive Theory

The descriptive Theory designates the relevant forces, identifies their attributes and explains the interrelationships. Accordingly, the Theory comprises three types of statements:

- **Structure:** statements that specify the concepts and the sub-concepts included in the Theory; in other words, the theory's structure. Examples: "The world is divided into MPEG and non-MPEG" (IND); "College' is different from 'university'" (EDU).
- **Attribution:** statements that ascribe attributes to concepts; for instance: "the technology progresses gradually", "The market is price-sensitive" (IND); "Engineers are pragmatic, result-oriented" (EDU).
- **Causality:** statements that define cause-and-effect relations between concepts. Examples: (1) "The product's decline is influenced by the customers" (IND); or: (2) "More students bring more resources" (EDU).

The theory is basically represented by the *cognitive map* format (Axelrod, 1976), which is limited to simple causality relations: variables, direction and ratio of influence.

4.1.2 Initial condition

These are specific qualitative values that are assigned to each of the primary forces in the cognitive map. By "qualitative" we mean high-low, increase-decrease or another contrasting pair (relative to the present state). The initial conditions *do not* reflect anticipation but possibility, so each primary force is assigned twice, one value at a time.

4.1.3 Scenarios

The scenarios are the testing hypotheses. A scenario is the integrated conclusion, across all the variables, which is deduced from the cognitive map under a set of initial conditions (one initial condition per primary force). The deduction conforms to the cognitive map's rules, i.e. an arithmetic exercise along each path. A prohibitive attribute is regarded effective until further notice, i.e. the ratio remains constant. It stems from the above that with n primary forces in the map there are as many scenarios as two to the power of n .

4.1.4 Environment

The "environment" stands for the actual values of all the variables included in the map, primary and non-primary alike, as observed in the real world.

4.2 Model

The model is adapted from Figure 1 and connects the constructs in a syllogistic structure:

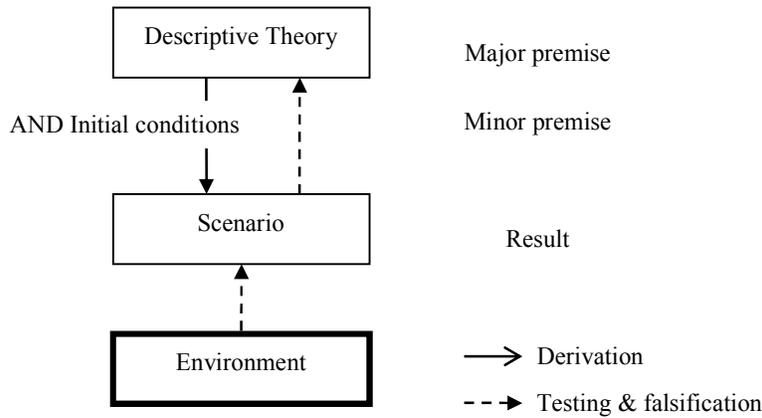


Figure 4. The design model

The logical notation of the model⁵ is as follows: let T be the descriptive Theory, let C be a set of initial conditions ($c_1, c_2 \dots c_n$), let S be the scenario and let E be the environment. Then:

$$\left(\left((T | (C = C_e)) \rightarrow S \right) * (S \neq E) \right) \rightarrow \bar{T}$$

⁵ This is an adaptation of Popper's formula: $((t \rightarrow p) * \bar{p}) \rightarrow \bar{t}$; in words: "if p is derivable from t , and if p is false, then t also is false" (Popper, 1961, p. 76). Whilst this formula applies the course of prohibition, the one developed here applies the course of initial conditions.

This reads: if the Theory, under initial conditions equal to the actual conditions in the environment, yields the scenario *S*, and if the scenario *S* is not materialized in (is unequal to) the environment, then the Theory is false (not-T).

4.3 Method

In addition to the logical requirements, the design has to cope with the "Falsification obstructer" along the route, namely *mindless derivation* and *mental irrefutability*. It is the duty of the method to confront them.

The method presents a two-phase procedure⁶: formalization and testing; the former establishes the platform for the latter. Table 7 spreads the techniques that assemble the method by phase and by the addressed obstructer; hereinafter the techniques are detailed.

Table 7. The method: techniques by phase and obstruction

Phase	Formalization	Testing
Obstruction		
Mindless derivation	Elicitation, explication and systematization of the Theory. Exhaustive and comprehensive derivation of the deducible scenarios.	Genuine and risky testing of the Theory.
Mental irrefutability	Exclusive focus on the "area of net interest" (detached from the normative and the design Theories).	Predefined hypotheses. Observations of basic statements.

FORMALIZATION

Mindless derivation

Elicitation, explication and systematization of the Theory: the elicitation of the Theory builds on two techniques in combination. One is the panel questioning method employed by Roberts (1976)⁷, aimed at constructing a cognitive map. The panel undergoes three rounds:

1. In the first round an assortment of variables is freely suggested, individually by each of the participants.
2. In the second round the variables are rated, integrated and clustered, as the outcome of collective consideration (which, Roberts testifies, is extremely uneasy).
3. In the third round the variables are interrelated and the relations are notated with positive or negative signs.

The panel method is amended according to the different purpose: instead of distant observers who are questioned after the fact we interview the decision-makers themselves in real-time.

⁶ It is a practical contraction of Popper's (1961, pp. 32-33) four phases: consistency, logicality, significance and confirmation.

⁷ This is one of the two unobtrusive techniques that Axelrod (1976) mentions. The panel consists of uninvolved experts and is conducted after the fact.

The other technique is the laddering interview, which "refers to an in-depth, one-on-one interviewing technique used to develop an understanding of how consumers translate the attributes of products into meaningful associations with respect to self, following Means-End theory" (Reynolds & Gutman, 1988, p. 12). We borrow the essential idea (to expose the attributes behind the causation) with one technical adaptation: a panel instead of personal interviews.

Beyond this, the explication is attained through the visualization of the verbal expressions in the cognitive map. The systematization concerns the distinction between the three types of statements, followed by: (1) aligning the attributes with the respective causalities, and (2) assuring the variability of the causal relationships.

Exhaustive and comprehensive derivation of the deducible scenarios: the scenarios reflect neither discretion nor anticipation; they are strictly derived from the map and encompass all the possibilities that the Theory allows. The exhaustiveness is achieved as each primary force is assigned with both poles of its spectrum, one at a time, where each assignment generates another scenario. The comprehensiveness is attained as each scenario integrates all the paths across the map.

The comprehensiveness enhances the scenario's falsifiability, in line with the Popperian principle of *logical probability* (Popper, 1961). The principle reads that the more conditions a theory has to meet, the less it is probable; the less it is probable, the more it is falsifiable – hence a better theory.

Mental irrefutability

Exclusive focus on the area of interest: the key countermeasure against the mental irrefutability is the distance from its sources: the normative and the design Theories. For the formalization of this technique we borrow a military concept.

The Western military doctrine⁸ divides the battlefield into two areas (Figure 5):

1. "An *area of influence* is a geographical area wherein a commander is directly capable of influencing operations by maneuver and fire support systems normally under the commander's command or control. The area of influence normally surrounds and includes the area of operations."
2. "An *area of interest* is that area of concern to the commander, including the area of influence, areas adjacent thereto, and extending into enemy territory to the objectives of current or planned operations. This area also includes areas occupied by enemy forces who could jeopardize the accomplishment of the mission."

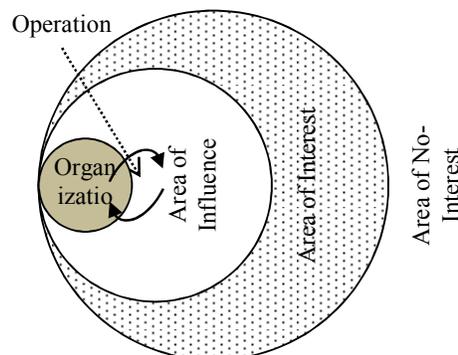


Figure 5. The organization and the areas of influence, interest and no-interest

⁸ The following excerpts are from "Operations", FM (Field Manual) 3-0, US Department of the Army, p. 5-5 (<http://www.army.mil/fm3-0/fm3-0.pdf>), visited April 10, 2010.

Save the "geographical", "fire" and "enemy", these concepts hold for civil organizations analogically. Our focus is on the dotted area, i.e. the area of interest *excluding* the area of influence (hereinafter: area of net interest). The sources of mental irrefutability are much less effective in the area of net interest: the no-control eliminates the "self-sealing" and the responsibility effects; the distance neutralizes the enactment; and the noninvolvement blunts the availability bias. To borrow from Axelrod (1976), the unobtrusiveness enhances the reliability.

The open-ended area beyond the area-of-interest is by default of no-interest (irrelevance); this is the zone of "there is unawareness". We have to confirm this statement in order to falsify the statement "there is no unawareness", which is equivalent to: "the outer envelope of the area-of-interest is true".

The rule for the inner envelope (i.e. the distant border of the area-of-influence) is "one up": the first variable that affects the industry, where the industry is one level above the subject organization. Preferably this variable (hereinafter: First cross-industry force) is beyond the industry's accumulated influence, i.e. insensitive to competitive maneuvers (for the sake of *net* interest).

Subject to these guidelines, the map is schematized in Figure 6; note that the *primary forces* are distinguished by bold letters.

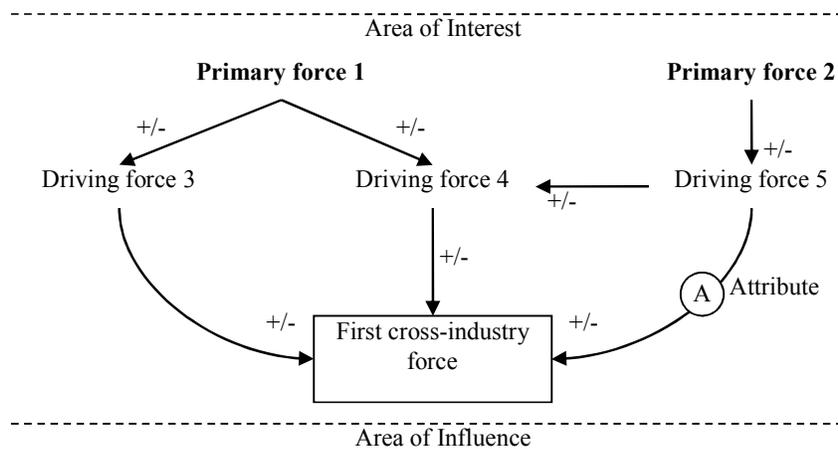


Figure 6. Schematic view of the Theory (the boundaries of the areas are for illustration)

By applying the "Exhaustive and comprehensive derivation of the deducible scenarios" technique on the map, the following schema⁹ emerges (Figure 7):

⁹ The graphical presentation is borrowed from Barabba (1998).

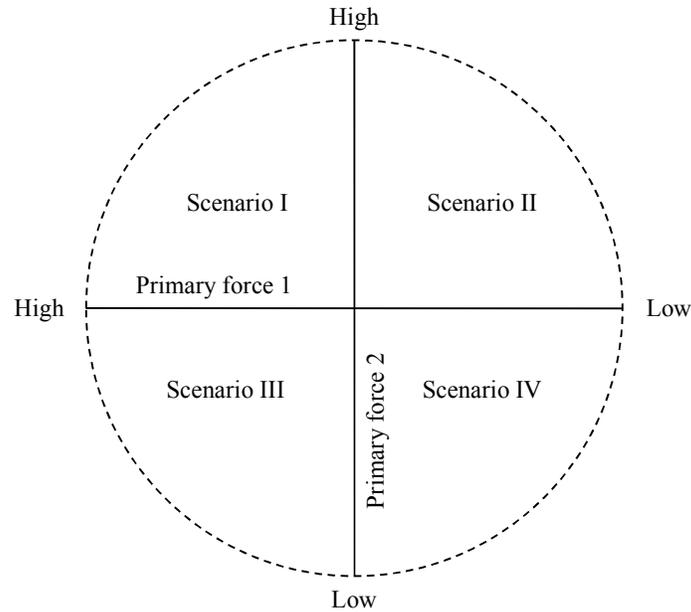


Figure 7. The circle of scenarios derivable from the Theory

TESTING

Mindless derivation

Genuine and risky testing of the Theory: this is the kernel of method. The testing procedure is conducted every 6-12 months, assuming that detectable changes require that time to evolve. The evaluator identifies the actual state of the primary forces in the environment, and singles out the scenario that has been assigned accordingly. Then the scenario, variable by variable, is compared to the real environment. A mismatch of one or more variable falsifies the Theory (or part of it).

For example (consider Figure 6): we look at the environment and conclude that, since the last test (or the theory's formalization), primary forces 1 and 2 have increased; therefore, if the theory is true, scenario 1 (Figure 7) should match the environment. We compare the real values of driving forces 3-5 and the "First cross-industry force" to those predicted by the scenario; a mismatch of any of them falsifies the Theory.

Mental irrefutability

Predefined hypotheses: the reason for predefining all the scenarios in advance rather than deriving the respective scenario in real-time (i.e. upon the test) is to prevent the "flexible environment" syndrome. We suspect that a derivation after the fact enables a flexible adaptation of the scenario to the reality or a retrospective justification thereof (as noticed in IND). The predefined scenarios force the decision makers to confront their original hypotheses and (with the next technique) amplify the inter-subjective objectivity of the method.

Observations of basic statements: Popper (1961) expects the observations to convey basic statements, i.e. "a statement of a singular fact". Unfortunately most of the theory's substance consists of social artifacts (e.g. "prestige") or abstract concepts (e.g. "competition"). If, as Popper argues, the observation at the nature is theory-laden, all the more so when the observed is an abstract concept (Hines, 1988). The interpretation of such observations is a conventionalist trap, Popper (1961) warns, since as conventionalists –

...we may adopt a sceptical attitude as to the reliability of the experimenter whose observations, which threaten our system, we may exclude from science on the ground that they are insufficiently supported, unscientific, or not objective, or even on the ground that the experimenter was a liar (Popper, 1961, p. 81).

As a countermeasure we require that the scenarios will be dissected down to the level of expected occurrences, i.e. basic statements. For example: "more than three competitors" and not "tough competition". The benefit is threefold: first, to focus the observations on empirical facts in the environment; second, to prompt undisputable comparisons between the scenario and the reality; third, to share common language across multiple sources (e.g. the media), and by that to obtain diversity.

4.4 Instantiation (Work Plan)

The method will be implemented in both participants with the researcher's facilitation. Once the Theory, the map and the scenarios are constructed, we will run the testing 2-3 times per participant, and evaluate. Next we will specify the learning.

Following are the participant-specific arrangements upon which we have agreed:

IND: the research will be conducted in the SBU level, namely twice, simultaneously. This was the management's preference in light of the different environment assumed for each SBU. Each SBU will involve the local management team, about 3-4 persons. One executive (the CTO) will represent the HQ in both SBUs, in order to synthesize the final evaluation. Testing is due approximately every six months.

EDU: the research will involve the strategic committee, a body assembled of the management plus several senior incumbents (in total about 20 persons). The president will sponsor the research and will evaluate its outcomes. Testing is due once a year.

5 FINALIZING THE FIRST CYCLE

5.1 Action Taking

IND

As planned, this phase of the research has been delegated to the SBU level and started in both SBUs quite simultaneously; unfortunately, SBU2 had been closed short before the research was completed, but nevertheless enriched the findings. For that reason and for the sake of brevity, only the products of SBU1 are presented, whilst the methodological insights integrate both experiments (which were by and large identical).

SBU1 develops equipment for broadband video streaming over phone lines, which enables phone companies ("Telco's") to supply television services. This ability is part of the "triple play", a strategy in which telephone, internet and television are supplied by a single provider. In this playground the Telco's (as of 2003) competed against the cable companies. For IND this is a demand market, directed by a limited number of customers with a great buying power each.

Formalization

Theory construction: we started the formalization phase with the Theory's *elicitation, explication and systematization*. The first round yielded about 15 variables, which were consolidated upon the second round into eight (12 in SBU2). The Theory construction consumed the largest time share, about 9 hours in 3 sessions. Two steps were particularly problematic: one concerned the designation of the "First cross-industry force", which was confused with the unit's own ends. Finally the decision was "Telco's broadband television (BTV) supply"; this

variable was assumed uncontrolled by the industry still with a direct effect on the competition, i.e. the area of influence.

The same difficulty was encountered by SBU2, whose products are consumed by plenty of anonymous end-users in the free market. The "First cross-industry force" they named was the size of the market, clearly beyond the control of each single competitor.

Once the "First cross-industry force" was agreed upon, the designation of the farther forces was straightforward. The second difficulty (in both units) emerged upon systematization, and was twofold: to name a variable rather than a state (e.g. "economic situation", not "recession"), and to assure the levelness of the causal relationships; close supervision of the researcher was required.

Testing

We conducted testing sessions every 6-10 months. The first two were indecisive, since the changes in the environment (primary and other forces) were too marginal to reach conclusions. The change in the work process, however, was salient: the environmental scanning was data-oriented, strictly focused on the indicators listed above; disagreements around observations were scarce.

The third session, that took place two years after the formalization, was different. The actual state of the primary forces indicated scenario 2 (Investment), but the environment partly resembled scenario 3 (Waiting) whilst the rest did not respect any scenario. Specifically, the Telco's invested very little in BTV equipment (part of the Waiting scenario) and cooperated with the cellular companies on content initiatives (not mentioned in any scenario). Apparently the Theory has been falsified.

The Theory was reviewed in attempt to specify the fallacy. One participant pointed to the missing of the emerging High-Definition (HD) technology, which he thought had caused the Telco's to wait until it would be assimilated, but there was no consensus about it. Another participant insisted that the Theory was not falsified at all, since the HD is wrapped in the "technology change" force, already in the Theory. Yet she acknowledged that the "delay" attached to the "technology change" variable was much longer than originally assumed. The debate would not be settled until the next session.

The fourth and last session was held after another eight months. The environment-scenarios contradiction continued, but much more disturbing was the results input: the company lags behind its objectives. Now the acknowledgement of a problem was unanimous. The bottom line is that a new driving force, claimed critical, emerged in the design Theory but was denied upon the descriptive Theory (that is, only the *design Theory* was falsified). The reaction to this discovery was: "it is a logical movement [in the market]... but I don't understand what we are trying to prove; this is the regular evolution in this industry".

EDU

As planned, the research involved the entire strategic committee, and was integrated in the strategic thinking process as its starter.

Formalization

There was an instant consensus around the "First cross-industry force", which reads "Demand for engineering education in colleges"; it directly affects the first variable within the area of influence, which is "Demand for studying in EDU". It is important to note that very few engineering colleges existed at the time, quite distant from one another, so the interest-influence border was thin.

Upon systematization, the IND-like difficulty with the levelness along the causal relationships was realized and required facilitation. The plenary session lasted about 15 hours, to which the teams' working time should be added.

The governing mindset along the formalization process held a competitive arena consisting of two groups: the universities on one hand and a few colleges on the other. The emanating strategy reflected this perception.

Testing

We conducted testing sessions once a year. In the first session scenario 4 was materialized without contradictions; save the insight that the effect of *Pace of knowledge renewal* is slower than assumed, the Theory was corroborated.

In the second session (two years after formalization) the economic situation turned up, so (with the "Slow pace of knowledge renewal" still) the actual conditions singled out scenario 3; however, the scenario did not fit the environment. Despite the evidenced increase in demand, the engineering colleges (IND included) have not grown.

The reaction to this finding was spontaneous: the Theory is false; and the pointing to the false assumption was as quick:

The competition among the *colleges* became tougher, and the larger amount of students is distributed across more institutions.

In other words, the *colleges-universities allocations ratio* is no more a factor; instead the significant ratio is of the colleges that provide engineering education to the colleges in total¹⁰. It is noteworthy that despite the intensive attention paid to the strategy throughout the period (and the explicit reliance of the strategy on the Theory), the falsity has not been noticed but upon the testing.

The falsification had an instant impact on the strategy, which was revised in line with the updated Theory. With that the phase ended.

Evaluation

Constructs

The **Theory**: we regard the completeness criterion as equivalent to the *validity* of the cognitive map; in this sense the criterion is partly satisfied. IND's participants accentuated the authenticity of the knowledge representation. The understandability was acknowledged by both participants: IND highlighted the clarity of the causal relations and EDU emphasized the common language gained through the mapping. The Theory appeared simple as well: around 10 variables, easy to represent and grasp. The structure-attribute-causality distinction is exhaustive and mutually-exclusive (i.e. complete) and understandably represented.

The negative aspect is that the Theory inherits the limitations embedded in the cognitive map; especially inflexible is the lacking time dimension (duration). The weak representation of duration was encountered in both implementations: in IND it concerned the "Technology change", and in EDU the "Knowledge renewal". The IND case demonstrates the damage of that limitation: it "mitigates" the falsity of the Theory and postpones the falsification. For example, the environment-scenario contradiction upon session 3 was explained that way: "There is no problem, this is the reality. The *Telco BTV supply* increases, slowly though, because the *Technology change* is lengthy".

As for the other limitations, the need for nonmonolithic expression is exemplified by IND's 1st scenario: "Under extreme circumstances the trend *turns over*", a relation that the Theory cannot exhibit. In the Theory of SBU2, which is not presented, we faced the need for *Conditional or interactive causation*: where one variable enables another one but does not drive it.

¹⁰ What happened was that the CHE has granted many colleges an engineering degree. Consequently the supply outnumbered the demand, although more than half the students learned in colleges.

In summary, the simplicity of the map is gained at the expense of its completeness, but the understandability is still fair; the limitations do not exceed the expectations.

The **initial conditions** stand all the criteria but ease of use: as happened in IND, a long time was required before they could render a meaningful, testable change. This limitation is inherent.

The **scenarios** meet all the criteria, especially the ease-of-use: no further contemplation is required thanks to the structured derivation from the Theory.

The **environment** construct meets all the criteria.

Model

The criteria concern internal and external validity (internal consistency and fidelity with the real world, respectively). The internal consistency is a priori, follows from the logical formalism; in contrast, the fidelity with the real world requires empirical evidence. This point is controversial.

Prima facie the answer is yes: each instance of $S \neq E$ (scenario unequal to environment) indicated a falsity in the Theory. Yet the participants' perceptions are contrasted. IND's evaluation questions both the reliability of the observations and the validity of the scenarios ("the argument that certain indicators signify a specific scenario, or that the Theory dictates only these and not other scenarios, may be incorrect"). In EDU, the opposite is true: "the scenarios' examination supports the Theory's falsification – and indeed, that's what happened".

So there is an "apparent disagreement" to explain (will be done upon "Specifying learning").

Method

Clarification: in this section we evaluate the procedure; the *impact* on the user is examined in the next section.

The method is operational, effective and efficient, but weak upon the ease-of-use criterion. The techniques vary by contribution to each criterion.

There is unanimous agreement about the effectiveness of the *Elicitation and explication of the Theory*, yet with a different emphasis. EDU's president highlighted the elicitation as an eye-opening vehicle:

The "Pace of knowledge renewal" is a variable that I did not notice before, as well as the "Economic situation". They definitely were not in my mind. The "Dominance of the values approach in education" issue was also unclear to me. In retrospect, it might have been the most significant discovery.

IND's participants were more satisfied with the explication, since in their opinion the elicitation was trivial. They liked the analytical modeling, the visual representation and the amplified awareness of the relationships granted by the analysis. They had two reservations: one, that not all the attributes had been unveiled; two, that the process was too long and too fragmented.

On the other hand, the *systematization* was difficult and required tight facilitation. The ladder-interview was efficient in extracting the attributes, but neither this nor the levelness of the causal relations could be reached without the researcher's involvement.

There was wide agreement about the effectiveness of the *Observations of basic statements*. Both participants noted that their scanning became much more focused and targeted. For example, in IND: "I gained much higher awareness of what to look around"; in EDU, the president stated:

The Theory's explication definitely sharpened my information needs. I notice elements previously unattended to.

The *Exhaustive and comprehensive derivation of the deducible scenarios* was efficient, and remarkably easy. As of the effectiveness, we may ask whether the "attributionalization" tactic applied on the steady forces violates the rule. The results show a positive balance, as the tactic does not undermine the logical line whilst is clearly more practical. In total the earned efficiency pays off.

The *Exclusive focus on the "area of net interest"* was effective, although counterintuitive for the participants. A special attention by a trained facilitator is required in order to keep the focus on track. The effectiveness is expressed by elimination: we did not encounter normative resistance when the Theory was falsified. The *Predefined hypotheses*, which the participants had to confront, contributed to that end as well.

The core technique of *Genuine and risky testing of the Theory* is also operational and efficient. The testing procedure succeeded to differentiate between corroboration and falsification of the Theory. However, the participants varied upon the ease-of-use of the testing and the understanding of its consequences (more about it shortly).

The similar results across organizations as varied as IND and EDU suggest that the method stands the criterion of generality.

Instantiation

We witnessed two different impacts of the method on the users:

- In IND, the design Theory is falsified whilst the parallel falsification of the descriptive Theory is denied; in other words, there is no mirroring. The strategy corresponds with the design Theory alone.
- In EDU, the descriptive Theory is falsified; the falsification is simultaneously projected on the design Theory, and the strategy is revised accordingly.

The participants evaluated the impact in light of their attitude. In IND:

This is all about the way of thinking.... We did not feel that the analysis had added to our understanding of the reality; we understand the reality anyway and know what is going on. We intuitively understand that there are these and other driving forces, and the forces are conceptualized in our mind. We think differently from the method: we notice that we do not sell and ask ourselves what the problem was. We definitely don't look for answers from the [descriptive] Theory. We take for granted some future scenarios and after the fact try to explain what was wrong. Even if the [descriptive] Theory is true, that does not guarantee the validity of the strategy.

Since the strategy obtains its validity from the design Theory, the last sentence denies the mirroring between the descriptive and the design Theories.

In EDU:

I [the president] have no doubt that the idea of "reality control" is right. As a manager I apply the scientific logic through process flowcharts [i.e. design Theory]. The method reminds us that science also means falsification [of the descriptive Theory], and in issues as central as strategy the hypotheses' testing is literally a must. The scenarios' examination supports the Theory's falsification – and indeed, that's what happened, fortunately still in time. After all

we are an academic institute, and our managerial attitude should be scientific as well.

In short he says: as a manager I lean on the design Theory; as a scientist I concern the descriptive Theory; the method connects both worlds.

Specifying Learning

In this section we theorize about the disagreements; in order to separate them we highlight the agreements first.

Agreements

Agreements were reached about the constructs and the method. Two aspects share a wide agreement in particular:

1. The contribution of the Theory's explication.
2. The effectiveness of the honed environmental scanning that the testing orientation dictates.

Disagreements

Two disagreements were detected, relating to:

1. The model, concerning its fidelity with the real world.
2. The instantiation and the inter-Theory mirroring.

The first disagreement is attitude-driven; IND's arguments indicate the entrenchment of the conventionalist (Kuhnian) stance. For us it signifies that the method failed to bridge the attitude gap.

The second disagreement suggests that the mirroring, again in IND, is not as straightforward as assumed. Common to both disagreements is IND's resistance against EDU's acceptance of the method. The deliberate diversity of participants was aimed at such occasion, so we ask which organizational idiosyncrasy could cause the differences.

A hint in this direction is EDU's testimony: "As a manager I apply the scientific logic through process flowcharts. The method reminds us that science also means falsification [...] After all we are an academic institute, and our managerial attitude should be scientific as well". This means: the scientific orientation drives both the not-to-be-conventionalist decision and the comprehension of the mirroring.

On that basis we theorize that (unless uniquely scientific-oriented) organizations face one more *falsification obstructor* between the descriptive and the design Theories. Since the Theories are claimed to mirror each other, we name the added obstructor *the "Broken mirror"* (figure 8).

The consequences of this theory on the second cycle are:

1. The intervention has to incorporate "scientific indoctrination".
2. The method has to take into account the *"Broken mirror"* obstructor.
3. Unlike EDU's uniqueness, the participant organization should not be scientific-oriented (but not too similar to IND).

The process hypothesis is updated accordingly (the update is underlined):

H2. The techniques employed throughout the method overcome the "mindless derivation", the "mental irrefutability" and the "Broken mirror" falsification obstructers.

Note that the agreements relate to *H1* (the environment). In the second cycle (described in the next chapter) the agreements are retested and the disagreements are explained through *H2*. Figure 8 below updates the theory.

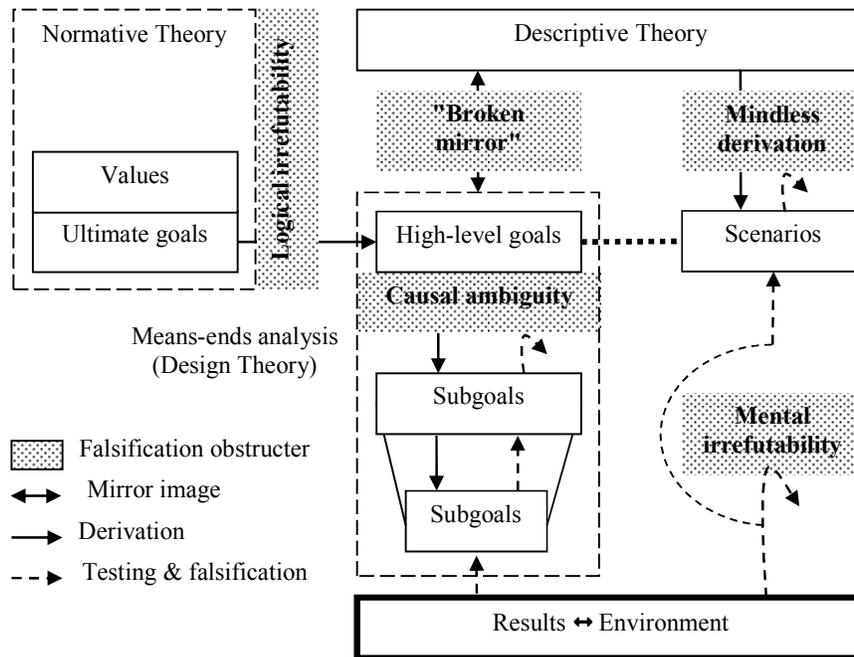


Figure 8. The *Falsification Obstructors* theory, updated

6. ACTION RESEARCH, CYCLE II

6.1 The Participant

Cycle II involved one participant: a software company nicknamed SOFT. The cycle was conducted during 2009, a year of which the first half was shadowed by the economic recession.

SOFT is a small Israeli private company, of about 20 employees, which is owned and run by its founder. The company specializes in IBM collaboration products and is an official IBM business partner. SOFT provides the full range of IT services including sales, development, implementation and maintenance. The company targets the enterprise market, usually for enduring contracts.

SOFT shares the business orientation of IND, but differs by size, structure and industry – hence an eligible participant. As the same important was the full-hearted willingness to participate.

SOFT's CEO (identified hereinafter as B') accepted my request to join the research for definitely the sake of curiosity. She received an explanation about the study, its theoretical ground and objectives, the action-research method, and was briefed about the 1st cycle. B' preferred not to involve subordinates in the research, because of their workload (a side-effect of the tough economic situation). Anyway, she stressed, nothing in the company is beyond her supervision.

B' has over 15 years of experience in the market, of which the last five in SOFT and the rest as a salaried senior executive in a larger company. A prominent characteristic of this particular market (in Israel) is its stability – mild competition among very few providers; B' is among the most experienced veterans.

6.2 Diagnosis

The normative and the design Theories were readily articulated; their utterances are quite often interwoven. Three underlying motifs can be extracted:

1. The tight, long lasting relations with the customer. The family metaphor is salient, epitomized by the repeated usage of the term "Catholic marriage". The firm believes in trust-based relations, long-run considerations and personal contacts.
2. The need-driven approach: the right way is to make the customer feel that he sensed the problem and then to respond with a solution. The motto is "need from the field".
3. The conservative, safe-bets attitude, which prefers flexible cooperative contracts whenever it is possible rather than bold investments.

Whilst the third principle is a tentative reaction to the economic constellation, the first two reflect a long-standing tradition which is to stay.

Unlike the solidness of these both Theories, the other constructs are sparse. The descriptive Theory mentions only concepts or attributes whilst empty of causality. No scenarios are mentioned save one: the IBM-conducted future; and the environment is a closed vendors-distributors¹¹-customers loop.

The expressions explain why these constructs are unheeded. First, the firm restricts its attention to the IBM environment, which is considered tightly regulated (by IBM). Second, there assumed to be enough sensors within this environment, so changes are anyway detectable. Third, "the business in which I operate is a very inexact science", so intuition or feelings are as the same valuable as a systematic surveillance. Forth, the results justify the attitude.

In summary, two problems are diagnosed in SOFT:

1. The Theory is static (no causality) and strictly confined; no attention is paid to the wider environment.
2. The sole validation method is the results control.

The scenarios' falsification obstructers do not apply since there are no scenarios.

6.3 Action Planning

Based on cycle 1 we added the "Broken mirror" as a falsification obstructer. In order to re-mirror we revise the method whilst the constructs and the model remain unchanged.

Method

The revision concerns the first formalization technique: instead of plain *Elicitation*, the technique consists of *Structured mirroring, explication and systematization* of the descriptive Theory. This is done in the following order:

1. *Explication* of the design Theory, with which the participant ought to be familiar.
2. *Structured mirroring* of the descriptive Theory through laddering, i.e. asking what rationalizes the design Theory.
3. Completion of the explication and systematization steps.

The remaining techniques still apply, except that the *area-of-interest* principle becomes more delicate; this is because the *mirroring* necessarily concerns the area-of-influence, so the *systematization* has to clear out the superfluous range.

¹¹ For distinction, IBM and Microsoft are labeled "vendors" and the secondary-market companies (like SOFT) are referred to as "distributers".

Instantiation

The method will be implemented in SOFT with the researcher's facilitation. Once the Theory and the scenarios are constructed, we will run the testing every 6 months until we can substantiate an evaluation. Next we will specify the learning.

The CEO is the single participant, as agreed upon the researcher-client agreement.

6.4 Action Taking

Formalization

Once the design Theory was explicated, we applied the *structured mirroring* technique. We departed from two major themes in the design Theory and went on toward the theory formalization through an extensive use of the *structured mirroring* technique.

Testing

The first testing was conducted 10 months later (4 months beyond schedule). The initial conditions have changed remarkably enough for determining the materialized scenario. We reviewed the scenario and the mismatch with the environment was conspicuous: more than half the indicators were not observed. B' immediately inferred that the Theory was falsified and started re-theorizing. We conducted the evaluation right after the testing.

6.5 Evaluation

Constructs

There are no new insights regarding this aspect.

Model

The empirical evidence for fidelity was reconfirmed. Concerning the disagreement about the users' acceptance, SOFT took EDU's side, and commented after the testing: "I accept the model... It made me critical. I can recognize that [the reality] is unlike [the scenario], and then I wonder why: because we have failed to take that [force] into account".

More than that, it was already upon the formalization when B' stated: "this scenario is less probable but still is possible [according to the Theory]. These two scenarios oppose one another but both are logically possible. *If we face a contradiction* [between the environment and the scenario] *we will know that the Theory is failed or that some factor is missing*".

Method

The revised technique (*Structured mirroring, explication and systematization of the Theory*) is operational: it worked to extract the descriptive Theory. But simple it is not, so the mirroring requires tight facilitation.

The other techniques were reemployed and were effective as before (including the worrisome *Exclusive focus on the "area of net interest"*), so the claim for generality holds.

Last but not least: the cycle reaffirms the low score on the ease-of-use criterion. The researcher's assistance was required throughout the whole process.

Instantiation

The impact on the participant was immediate. The Theory's falsification was crystal clear and the participant accepted it with no reservations. Two consequences followed:

- The participant retrieved previous cues she had encountered and reinterpreted them in light of the revised Theory: "I did not react to those signals. I have never thought

about it that way; but now... because of the freeware [concept], all these signals make sense".

- She instantly mirrored the Theories, this time in the design direction: "I understand that it means some [strategic] change... I have to think what I can do about it".

Later she announced her intention to reiterate the process a year later.

6.6 Specifying Learning

The agreements reached upon the first cycle were reconfirmed, concerning the constructs and the method.

The specific hypothesis targeted in this cycle, i.e. the "*Broken mirror*" obstructer, was corroborated from two directions:

1. The obstructer was detected upon formalization.
2. Once the method was adapted according to that hypothesis, the disagreements encountered in the former cycle were settled.

Overall conclusions are discussed in the next (and last) chapter.

7 DISCUSSION AND CONCLUSIONS

7.1 Discussion

An essential part of the discussion – that is, the method evaluation – was carried out at the respective phase in the research. In this section we discuss additional issues beyond strict evaluation.

The applicability of the method

All the three participants experienced difficulties during the method's implementation. The difficulties culminated toward formalization and diminished towards the testing, being the systematization the most problematic. The need for specialized facilitation was evident; even a participant as science-oriented as EDU could not handle the theorization independently. It seems unreasonable that the method can be prescribed as a recipe.

However, this is not an exception. Many management tools require professional escort and still are ubiquitous (e.g. ISO, balanced score card, or dialectic inquiry). Whilst this difficulty is surmountable, more troubling was the normative resistance that the managers demonstrated against the root idea: to pursue unknown problems. The common stance was that the already-known problems were enough.

A typical reaction in IND indicated that the problem recognition phase is beyond the management attention: "our thinking order is: what's the problem, to whom the problem may concern, how many profits can a solution yield, and which share of it we can seize". EDU presented a similar reaction, although not as blatant: the post-falsification strategic revision was soon halted; in the president's opinion it happened because the problem was not yet a crisis when recognized.

SOFT's CEO commented that "without a crisis managers do not check their paradigms" (she wished she was exceptional); Mintzberg et al (1976) reached the same conclusion four decades ago. The attitude (as Popper claimed) is the root obstructer and the main disabler, not the difficulty of the method.

Scenarios

The concept of scenarios is a known and popular management tool (used by 42% of the respondents to Bain & Company's survey, 2009¹²). A by-product of the method, beyond the falsification function, is the improvement of this tool per se.

First, in the management literature the Theory and the scenarios are interwoven and undistinguishable (this is what the *mindless derivation* is about). The traditional generation of scenarios is dialectic and yields a three-tenet, eclectic construct; Schoemaker (1993) counts the three: "[scenarios] may present antithetical world views. In terms of inquiring systems (Churchman, 1971), scenarios are Hegelian in their underlying philosophical premise [...] The gist of the scenario method seems that it is many things: art and science, deduction and induction, structure and fluid..." (p. 194). In contrast, the method we suggest produces scenarios with a coherent orientation: scientific, deductive and structured.

Second, the traditional method substitutes the answer for the question. Schoemaker (1995) asks and answers: "How can you determine if your final scenarios are any good? The first criterion is relevance" (p. 30). Our stance is that the relevance is the very *question*, and the "goodness" concerns the Theory from which the scenarios are deduced.

Third, the traditional scenarios presuppose the interactions of the firm with its environment (Schoemaker, 1995), thus are sensitive to enactment; our method enables a better distinction.

The cognitive mapping

Axelrod (1976) limits the cognitive map to represent only the causal Theory; other sorts of Theory are excluded. The virtue of the limitation is the map's unequivocalness: "The more types of images, arguments, and assertions that are allowed into the map, the less chance that the map can be coded the same way by two different coders" (Axelrod, 1976, p. 260). Since in our instance the "coder" is the Theory holder (rather than a third party), we are exempted from this limitation. In this sense we introduced the *attribute*, which as a constraint on causality enhances the Theory's falsifiability.

Beyond causal representation, the method promotes concept formation (recall SOFT's decomposition of "reliability"). It is a by-product of the cognitive mapping notion that extends its functionality.

7.2 Conclusions

The research objectives

The research objectives were announced as follows:

1. To explicate the Popperian face of organizations in order to posit a competing theory to the *inadequacy argument*.
2. To corroborate the competing theory and by that to supplant the *inadequacy argument*.
3. To counteract the unawareness problem.

The first objective was attained through the literature review. Based on fragments of Popperian-like manners the *falsification obstructers* theory was introduced. Toward the second objective we derived three hypotheses from the theory and designed an organizational method aimed at their testing. The first hypothesis (twofold) concerns the environment:

H1a. The organization's environment can be theorized in a falsifiable fashion.

¹²http://www.bain.com/bainweb/publications/publications_detail.asp?id=27075&menu_url=publication_s%5Fresults%2Easp; visited April 9, 2010.

H1b. The right route is capable of obtaining unequivocal falsification.

This hypothesis was confirmed across both cycles. As for the second hypothesis that concerns the organization, its first version was challenged upon the first cycle. The source for the conflict was hypothesized and the pertinent technique was revised toward retesting. The essence of the update is that the "right route" is ineffective unless explicitly connected to the left route. The updated hypothesis reads:

H2. The techniques employed throughout the method overcome the "mindless derivation", the "mental irrefutability" and the "Broken mirror" falsification obstructers.

The hypothesis was tested and confirmed upon the second cycle. The ultimate objective is attained through the falsification route that *H2* indicates (figure 9). The act of re-mirroring (signified by the black dot) engenders the interface between the Popperian and the organizational conceptualizations.

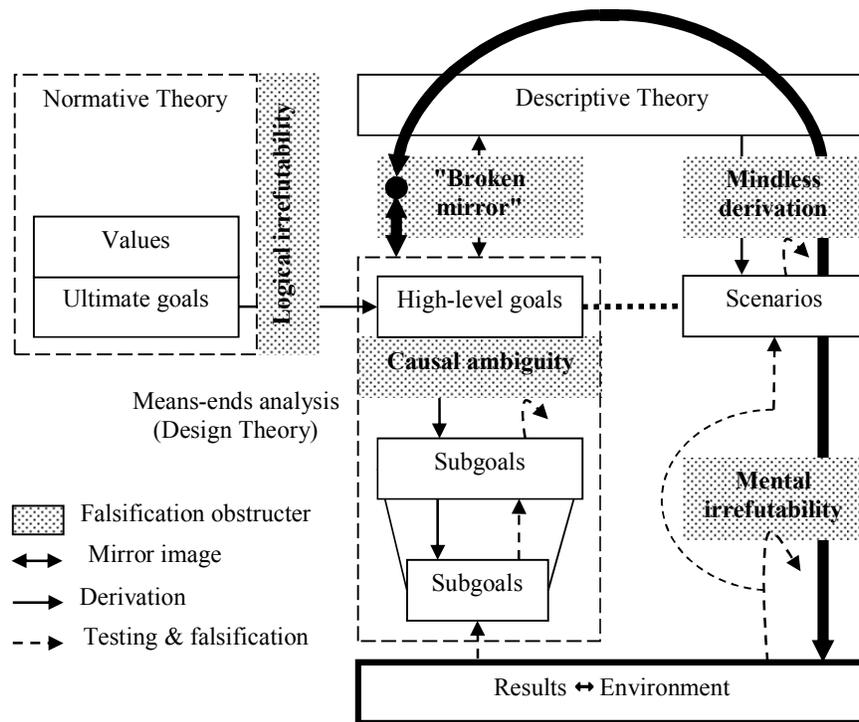


Figure 9. The organization's "Theoretical System" and the falsification route (marked by the thick arrow)

REFERENCES

- Argyris C (1976/a) *Increasing leadership effectiveness*. Wiley, New-York NY
- Argyris C, Putnam R, Smith DM (1985) *Action science*. Jossey-Bass, San Francisco CA
- Axelrod R (1976) *Structure of decisions: cognitive maps of political elites*. Princeton University Press, Princeton NJ
- Barabba VP (1998) Revisiting Plato's Cave: Business Design in an Age of Uncertainty. In: Tapscott D, Lowy A, Ticoll D (Eds). *Blueprint to the Digital Economy*. McGraw-Hill, New-York NY (pp: 34-59)
- Baskerville RL, Wood-Harper AT (1996) A critical perspective on action research as a method for information systems research. *Journal of Information Technology* 11 (3): 235-246
- Baskerville RL, Wood-Harper AT (1998) Diversity in information systems action research methods. *European Journal of Information Systems* 7 (2): 90-107
- Brown JS, Duguid P (2000) *The Social Life of Information*. Harvard Business School Press, Boston MA
- Bruner JS, Goodnow JJ, Austin GA (1956) *A study of thinking*. John Wiley & Sons, New-York NY
- Christensen CM (1997/b) *The Innovator's Dilemma: When New Technologies Cause Great Firms to Fail*. Harvard Business School Press, Boston MA
- Cunha PR, Figueiredo AD (2002) *Action-research and critical rationalism: a virtuous marriage*. Proceedings of ECIS 2002, Gdansk, Poland
- French S (2009/a) Action research for practising managers. *Journal of Management Development* 28 (3): 187-204
- Hatchuel A (2005) Towards an epistemology of collective action: management research as a responsive and actionable discipline. *European Management Review* 2 (1): 36-47
- Hines RD (1988) Financial accounting: in communicating reality, we construct reality. *Accounting, Organizations and Society* 13 (3): 251-261
- Järvinen P (2005) *Action research as an approach in design science*. University of Tampere, Department of Computer Sciences, Series of Publications D – Net Publications, D-2005-2. Presented in the EURAM (European Academy of Management) Conference, Munich, May 4-7, 2005
- Kemmis S, McTaggart R (2000) Participatory action research. In: Denzin NK, Lincoln YS (Eds). *Handbook of qualitative research*. Sage, Thousand Oaks CA (pp: 567-605)
- Lau F (1999) Toward a framework for action research in information systems studies. *Information Technology & People* 12 (2): 148-175
- Lindgren R, Henfridsson O, Schultze U (2004) Design principles for competence management systems: a synthesis of an action research study. *MIS Quarterly* 28 (3): 435-472
- March ST, Smith GF (1995) Design and natural science research on information technology. *Decision Support Systems* 15 (4): 251-266
- Mintzberg H, Raisinghani D, Theoret A (1976) The Structure of "Unstructured" Decision Processes. *Administrative Science Quarterly* 21: 246-275
- Mitroff II, Mason RO (1981) The metaphysics of policy and planning: a reply to Cosier. *Academy of Management Review* 6 (4): 649-651

- Morrison JL, Mecca TV (1989) Managing Uncertainty: Environmental Analysis/ Forecasting in Academic Planning. In: Smart JC (Ed). *Higher Education: Handbook of Theory and Research*. Agathon, New-York NY (pp: Vol. 5 334-382)
- Popper K (1961) *The Logic of Scientific Discovery*. Science Editions, New-York NY
- Reynolds TJ, Gutman J (1988) Laddering theory, method, analysis, and interpretation. *Journal of Advertising Research* 28 (1): 11-31
- Roberts FS (1976) The questionnaire method. In: Axelrod R (Ed). *Structure of decisions: cognitive maps of political elites*. Princeton University Press, Princeton NJ (pp: 333-342)
- Schoemaker PJH (1993) Multiple scenario development: Its conceptual and behavioral foundation. *Strategic Management Journal* 14 (3): 193-213
- Schoemaker PJH (1995) Scenario Planning: A Tool for Strategic Thinking. *MIT Sloan Management Review* 36 (2): 25-40
- Susman GI, Evered RD (1978) An Assessment of the Scientific Merits of Action Research. *Administrative Science Quarterly* 23 (4): 582-603
- Walls JH, Widmeyer GR, El Sawy OA (1992) Building an Information System Design Theory for Vigilant EIS. *Information Systems Research* 3 (1): 36-59