

Managing Complexity—The Path Toward Intelligent Organizations

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Coping with complexity is at the heart of management and leadership in the turbulent environments faced by the organizations and societies of our day. The systems approach provides transdisciplinary theories and tools for dealing with this challenge more effectively than efforts merely based on disciplinary insights or pragmatic recipes. In this paper, a concept of “intelligent organizations” is introduced. A framework for the design of intelligent organizations is proposed that links three organizational cybernetic models: the Model for Systemic Control, the Viable System Model, and the Team Syntegrity model.² The proposition is that a combined use of these models, guided by the integrative conceptual framework, enables a more effective response to complex situations than merely pragmatic approaches to “integrative management.” Provisional empirical evidence gathered from applied research indicates that the proposed framework is capable of enhancing such superior potential for effective response. As such, it promises to meet the specific needs of the new types of organizations that have already begun to emerge in the knowledge societies.

KEY WORDS: organizational cybernetics; management of complexity; organizational intelligence; systemic control.

1. INTRODUCTION

We live in a world of organizations; all of us depend on their functioning and well-being to a large extent. Therefore, organizational issues are of high priority and almost ubiquitous interest. Yet in general, the thinking about organizations is still rather disorganized. This is a problem, because we shape our organizations, and then they shape us. Tell me what your organizations are like, and I shall tell you who you are. If our world is in crisis, this is to a large extent a function of regulatory problems—problems of auto-control, self-steering, and self-refer-

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²As Team Syntegrity is usually referred to as a methodology, the word *model* is not capitalized.

ence. Much of this crisis can be traced back to organizational pathologies, and, ultimately, to deficiencies in our thinking about what organizations should be and how to conceive them.

But thinkers and actors seem to be caught in a double-bind. Trying to solve a complex organizational issue on the basis of one discipline—microeconomics, sociology, psychology, technology, etc.—is an elegant way to optimize in one single dimension, but therewith it paves the evil way to unstable or even chaotic behavior of the system in question. Conversely, adding multiple disciplinary solutions is cumbersome, and usually incurs the erection of a “Tower of Babel.”

Given this difficult situation, all kinds of efforts have been made to solve this double-bind problem—from calls for “mixing and matching” different methodologies (cf. Mingers and Gill, 1997) to varieties of pragmatic (and sometimes even esoteric) recipes. No wonder the management books and consultancy markets have thrived on buzzwords, fads, and sometimes outright charlatanism.

In the middle of all this confusion, a slow but steady rise in the relevance and acceptance of a scientific program has been evident: the sustained effort to build theories and models that look at the invariant features of complex systems called “the systems approach,” which is based on systems theory and cybernetics. This scientific endeavor, though refraining from riding the fad and fashion waves besieging management theory today, provides a formal apparatus for dealing with complex systems of all kinds, and is therefore being adopted increasingly in many fields of inquiry. Systems theory and cybernetics is also recognized as a new “language” that allows synergetic interaction between different disciplines, thus increasing the possibility of innovative, transdisciplinary solutions to complex issues.

The systems approach has become the scientific basis for a new management science that strives for an integrative, holistic effort to the design, control (involving steering and regulation), and development of organizations and social systems in general (Ulrich, 1984). It has provided the conceptual basis for research and education in general management at the school from which I come (University of St. Gallen, Switzerland) for 30 years. This has been a very fertile approach, and for good reason. No other approach performs as well in helping social systems cope with issues of dynamic complexity, with all the related organizational and even ethical challenges. Organizational cybernetics—the application of the science of control and communication in complex systems (e.g., by Stafford Beer and his pupils)—furnishes the structure–theoretic underpinning for humanistic postulates such as autonomy, meaningful work, and human self-realization. Works in general systems theory (e.g., Anatol Rapoport and his pupils) also open innovative paths toward peace and sustainability (cf. Schwaninger, 1998).

2. COMPLEXITY AND THE CONCEPT OF ORGANIZATIONAL INTELLIGENCE

Recently, a famous company presented itself with the battle cry “fast, lean, and strong.” My immediate reaction was “and bumb?” “Fast, lean, and strong” is not enough! Every day, corporations stricken with “organizational dementia” produce disastrous consequences for their economic, social, and ecological environments, despite the fact that their members, on average, are intelligent and capable of learning. Conclusively, organizational intelligence cannot be equated with human intelligence.

How organizations should be conceived so as to be capable of behaving intelligently in a comprehensive sense is therefore not a trivial question.

From a cybernetic stance, the intelligence of an organization embraces the following abilities:³

- to adapt to changing situations
- to influence and shape its environmental milieu
- if necessary, to find a new “playing field,” or to reconfigure itself anew with its environment
- to make a contribution to the sustainability of the larger wholes into which it is embedded

Potential to develop these faculties can, as will be shown, be created intentionally. Organizational intelligence is intrinsically linked to the ability to deal with complexity virtuously, and both are at the core of organizational cybernetics. Let us first analyze the role of complexity to get beyond the naive use of that over-promulgated catchword. A technical term for “complexity” is “variety”. This is a synonym for “multiplicity,” which expresses the number of different states or modes of behavior a certain system, let us say a company, or also a market can adopt. The scheme in Fig. 1⁴ visualizes that an agent—be it a company, an organizational unit, or a manager, is embedded in an environmental milieu, the variety of which by far exceeds the variety of the agent.

A practical example: for a citizen who wants to entrust a bank with his savings but is not a capital markets expert, it is almost impossible to orientate himself in the “jungle” of offers. Some time ago, I tried to determine from different banks whether I could not do better than an ordinary bank account by depositing my money in a different facility. I had the following reoccurring experience: the banking clerk confronted me with two or three options—a so-called high-interest bank account, and perhaps one or two bonds, with a “take it or leave it” attitude. What I would have wished to see, however, was a simple graph with three dimensions—risk, yield, and ecological performance—which would have given

³In extension of Sternberg 1987.

⁴In extension of Espejo/Watt 1988.

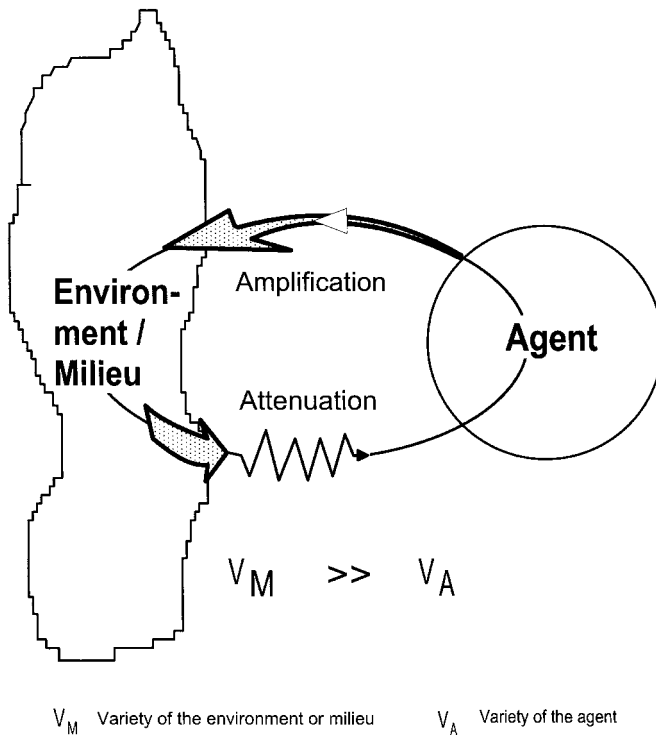


Fig. 1. Difference of varieties between an agent and its environment.

me an immediate overview of the number of options available. Nobody was able to show me that. Cybernetically speaking: the variety, or the repertory of potential behaviors of these banks was insufficient to cope with the complexity of the situation.⁵

3. TWO FUNDAMENTAL THEOREMS

The first theorem essential in this context is the Law of Requisite Variety formulated by the eminent cybernetician Ross Ashby: “only variety can absorb variety.”⁶ Ashby’s law is as fundamental for managers as the laws of thermodynamics are for engineers. It has a cogent implication of enormous bearing:

⁵ A recent survey of the financial-services sector, published in the *Economist*, suggests that the single incident reported here is an ideal-typical symptom of an industry in crisis heading for a radical shake-up (Drucker 1999).

⁶ In the original “only variety can destroy variety” (Ashby 1956), the verb “absorb” was later introduced by Stafford Beer.

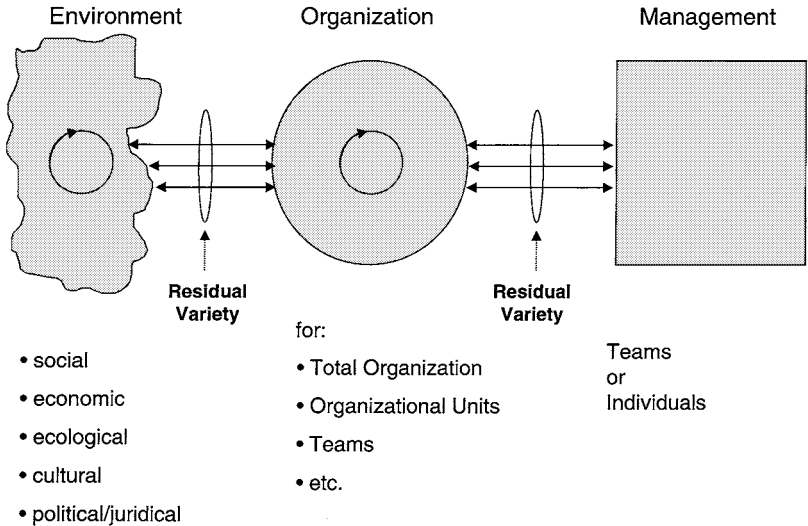


Fig. 2. How organizations and their managements cope with complexity.

to keep a complex system under control, the control-system must dispose of a variety which equals the variety of the system to be controlled. This sentence has often been grossly misunderstood. Such misunderstanding appears to be the case in those organizations that have built up structural complexities that have become unmanageable.

The quest should rather have been to build up eigen-variety, in other words, behavioral repertory, in order to attenuate foreign variety, i.e., complexity of the environment, and to also select a milieu the organization can cope with. This latter aspect is crucial in managing complexity, because one regularly observes organizations that define their environments in such a way that they confront complexities they are unable to deal with. The challenge is to balance the varieties of the interacting systems through both attenuation and amplification (cf. Fig. 1). Beer (1979) uses the term “variety-engineering” in this context.

One must add that the system at hand is not primarily subject to exogenous control, but that it regulates and steers itself to a large extent. These forces of self-organization must be leveraged consciously. The management of a company would not be confronted with the totality of problems occurring inside the organization, because most of them can be solved autonomously within the subsystems. It is only supposed to face the residual variety, i.e., those issues that cannot be brought under control by these subsystems themselves (Fig. 2).⁷ The same applies to the relationship between organization and environment. I take

⁷The concept of Residual Variety goes back to Espejo (1989).

the case of an insurance company that can screen off the bulk of their market complexity as a network of insurance agents efficiently absorbs that variety. The company itself can then concentrate on designing products and on honing its informational and financial skills.

The design of organizations can essentially revert to three types of amplifiers and attenuators—cognitive, structural, and interactional/conversational ones. Without laying these out in detail, I should like to address a second theorem that is most insightful for the design of amplifiers and attenuators. This is the Conant–Ashby Theorem, which derives directly from the Law of Requisite Variety. It says: “every good regulator of a system must be a model of that system” (Conant/Ashby 1981). In other words, *the result of an organizational process cannot be better than the model on which the management of that process is based, except by chance.*

This proposition contradicts commonplace “knowledge”, which often claims that management models are a thing of the past. Arguments of this kind fail to consider that all managerial activity is based on models, whether the respective agents are aware of it or not. In the light of the Conant–Ashby Theorem, most of the more or less trivial recipes given by current bestsellers on management must be disqualified as insufficient and even dangerous.

A serious problem is that many organizations are still managed on the basis of inadequate models. The traditional models of management are almost exclusively oriented toward profitability. The ROI (return on investment)-based system of indicators is well-proven but is insufficient, because in a context of rapid change, profit rates are inadequate to measure the performance of an organization. In principle, they are not much more than short-term and partial indicators of the success of a business. The pertinent models do not have requisite variety. Therefore, relying on them is likely to be misleading; they will probably point precisely in the wrong direction. The following analogy is useful: assessing the effectiveness of a business by the level of its profits is like measuring the temperature to decide what season one is in; for this purpose, the calendar, not the thermometer, would be the appropriate source of information. Long-term-patterns are driven by different causal mechanisms, which double-entry bookkeeping is unable to ascertain. It is essential to make this point in the face of the frenzy of the “management by financial figures”, in which short-term-thinking tends to drive out long-term-orientation.

These critical remarks are not meant to question the relevance of profits as such. In the long run, no company can survive without being profitable. Profits are a prerequisite to realize investments and to maintain the substance of a firm. In Peter Drucker’s precise words, profits are “the cost of staying in business” (Drucker, 1980). But if profits are necessary for the survival of a company, profit-mindedness is not apt to ensure its viability and development. On the contrary, the often cited goal of profit-maximization is an obstacle rather than

a genuine orientator toward greater organizational intelligence. The next section will elaborate on newer models that show a much higher potential for coping with complexity effectively than the established one criticized here.

4. MODELS FROM ORGANIZATIONAL CYBERNETICS, WITH APPLICATIONS

In this section, three models of organizational cybernetics and reports on some of their applications shall be expanded. These models will then be integrated by means of a proposed “Framework for Intelligent Organizations.” I will have to limit myself to the essential features of these models and call attention to the original sources.

4.1. The Model of Systemic Control

Under the “evolutionary pressure” of increasing complexity and turbulence, important progress has been made with regard to the knowledge about criteria for competent management. Control models that dispose of a much higher variety than the traditional ones have emerged.

The essence of this progress is based on the insight that a system must govern itself by means of control variables that may contradict each other because they belong to different logical levels: the levels of *operative*, *strategic* and *normative* management. In Fig. 3, the *Model of Systemic Control (MSC)* is depicted. As shown in this diagram, there are interrelationships among these levels; specifically, the control variables of the higher logical levels exert a pre-control influence on the lower ones.

For a business, the control variables essential to the operative level are liquidity and profit. We know that since Luca Pacioli introduced double-entry bookkeeping (in 1494), that these are two distinct objects of thought and action. Note that until then, this had not been known! For anyone understanding “modern” bookkeeping, the *pre-control effect* that profit exerts on liquidity should be clear. If profit is strong, this will affect liquidity positively. This effect will usually occur with some time lag, because the time-related natures of profit and liquidity are distinct: *liquidity* materializes immediately as a consequence of income and expenditure. *Profit* has a longer time horizon (cf. horizontal axis in Fig. 3), because its determinants—revenues and costs—span greater periods. There are costs that do not accrue in one event of consumption, but which accumulate over longer periods and are independent of the respective payments, e.g., interest and depreciation. Also, in most firms, a large portion of the revenues is only paid with some delay, after the delivery of the merchandise. Consequently, the determinants of profit, revenue, and cost, and those of liquidity, income, and expenditure, are booked separately. The implication for control is that the level

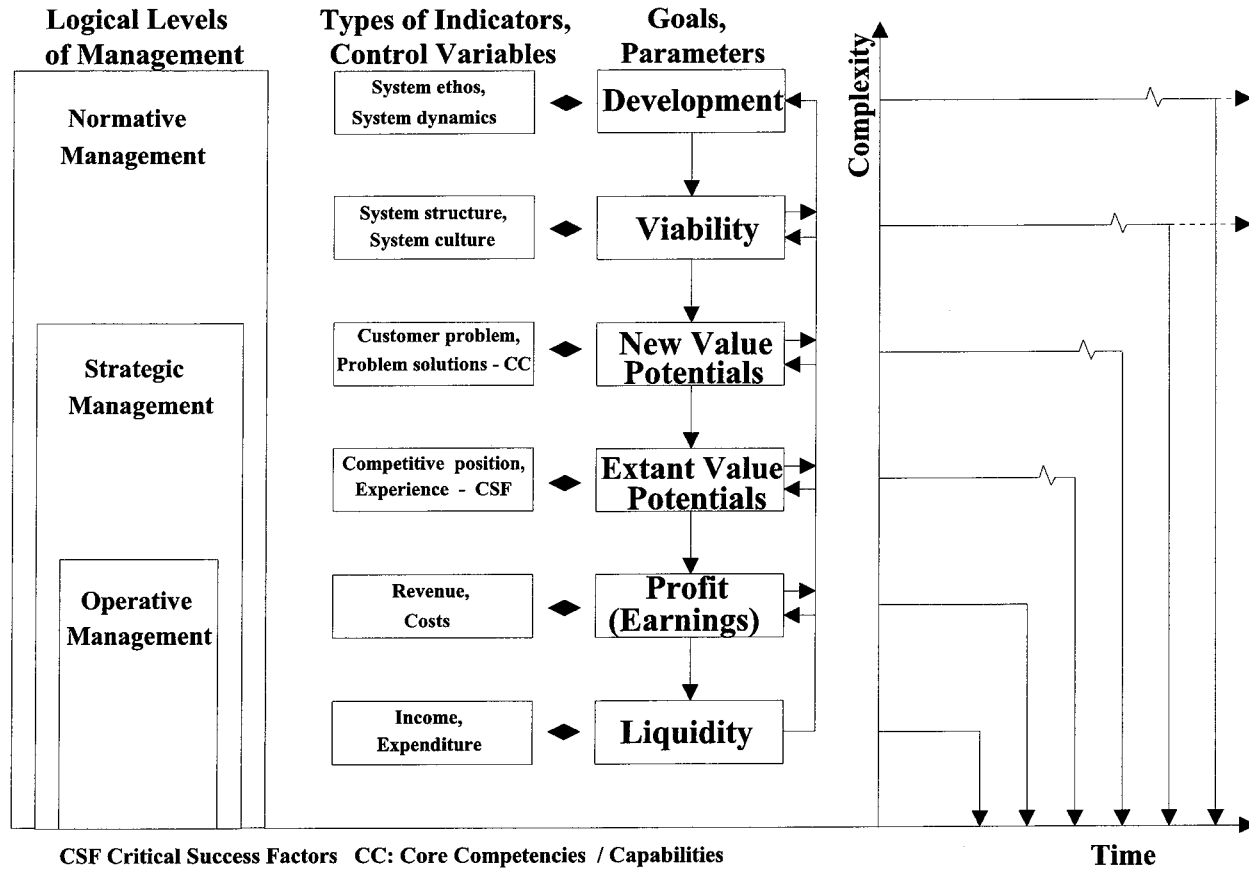


Fig. 3. Goals and orientators at different logical levels of management (version for private firms, abridged for didactical purposes).

of profit is an early warning indicator in relation to liquidity. If profit is negative once, this can be compensated for with accumulated reserves or via credits. However, the longer such a situation persists, the more difficult it becomes for a firm to maintain liquidity. Once maintenance of liquidity becomes impossible, bankruptcy is the consequence. So much for the operative level.

Only recently has a theory become available that makes the control variables and parameters of the higher logical levels accessible for analysis and understanding (cf. Gälweiler 1990; Schwaninger 1989, 1993). These are essential components of an advanced management model: they disclose the really powerful levers for influencing the destiny of an organization, i.e., the control parameters of the strategic and normative levels. These exert a pre-control function in relation to those of the operative level just outlined (cf. Fig. 3).

Pre-control is about the anticipative creation of prerequisites at a higher logical level for effective control at lower logical levels of management, as shown in Fig. 3. To use a descriptive and very common example: why do successful firms achieve sustained profitability? The answer is a very general one: apart from steering events over the months to achieve a positive balance between revenue and costs in their profit and loss statement at the end of the year, they have an effective higher level control mechanism in place: this one does not steer for profit itself, but for achieving it in the future. Therefore, it is concerned with prerequisites such as competitive position and other factors that impinge on future profits. This will be further elaborated in a moment.

4.1.1. *Figure 3: Goals and Orientators at Different Logical Levels of Management (Version for Private Firms, Abridged for Didactical Purposes⁸)*

Just as profit largely determines liquidity, *value potentials* pre-control profit. What are value potentials? These are the set of all applicable business-specific prerequisites that must be actualized when profits are to be achieved (after Gälweiler 1990). Value potentials must be steered separately from profit and liquidity on the basis of independent criteria.

Pre-control, in this context, signifies that the occurrence of profit and other kinds of value (cf. also Fig. 4) in the medium and longer term is strongly determined by the existence or absence of value potentials. In other words, value potentials are a necessary prerequisite for the realization of value. This does not imply that they are a guarantee (or sufficient prerequisite), as would be the case if we dealt with a mechanical system.

Research on strategic management has clarified the nature of the control variables for strategic management and has shown, for instance, how to apprehend the critical success factors, (such as market share, relative market share,

⁸To complete the picture, see also Fig. 4.

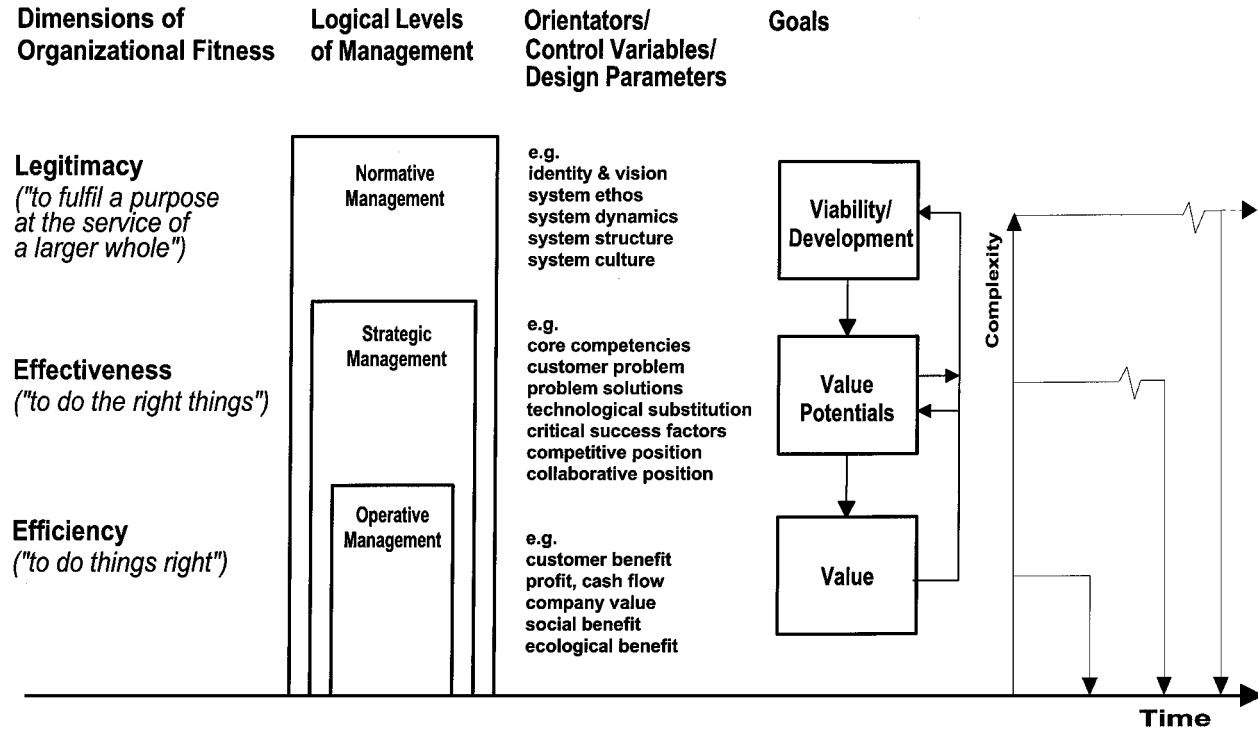


Fig. 4. Goals and orientators at different logical levels of management (generalized version).

potential quality/customer benefit, speed, flexibility, etc.) and core competencies. Getting clarity about the state of these orientators and their pre-control influences on the lower level “parameters”⁹ is essential for the leaders of any organization.

Within the level of strategic management, a logical differentiation is necessary. It is reflected in the distinction between extant and new value potentials. The determinants of each are characterized by distinct time constants, and they may reflect a different logic. For example, in many businesses, large market share and a strong brand may have been critical success factors and therewith reliable indicators of *extant value potentials*, i.e., a relative assurance for sustained profitability over a few years.

With regard to a longer time horizon, a very powerful orientator is the solution-invariant definition of (manifest or latent) customer problems¹⁰ posed in relation to solutions that are:

- (a) currently available
- (b) still in the development phase
- (c) potentially available, i.e., still in the research process (Gälweiler 1990)

This is essentially related to the phenomenon of technological substitution. To give an example: as electronic channels of distribution and service substitute the traditional ones, only those firms survive that are prepared for these new modes of doing business, having built up *new value potentials* through persistent organizational and product/services innovation. If customers appear to “desert to digital markets” (Ellis 1999) all of a sudden, this “suddenness” says more about the nonpreparedness of the firms that lose the game than about the new phenomenon itself. They should have prepared for this (and most of them could have) by anticipating this technological substitution, and building up the necessary competencies in time. Starting earlier is more powerful than simply acting faster.

Similarly, breaking free from the trap of “competitive convergence” (Kim and Mauborgne 1999) requires questioning the conventional wisdom about how to compete, by reframing the problem, reinventing the game, and avoiding head-on competition. The leapfrogging of competitors in turbulent markets is mostly founded on a redefinition of the relevant market, or a new perspective of the customer problem and the superior benefit provided by new solutions.

Some firms are questioning what their business is. General Electric, ABB, and other producers of investment goods have increased the service component

⁹ Whatever is a parameter on a given level can be considered an outcome variable from the stance of the higher (pre-control) level.

¹⁰ I prefer the term customer problems to customer needs, because, in principle, the value for a customer is more sustainable if a problem is solved superbly than if merely more or less ephemeral needs are covered.

of their businesses dramatically. Moreover, many of them have become involved in leasing, maintenance, or other aspects of value enhancement. Others have “created” new markets, or more precisely, uncovered latent market potentials. In the U.S., for instance, new services firms have emerged in areas that used to belong to the domain of self-service. Some examples are online services for shopping and meals, and personal-services companies that provide for housework, etc. In Europe, travel experts have started to earn their fees from consulting to corporate customers as their income from airline commissions is threatened. Some have shifted the appeal dominant in their industry from functional to emotional (e.g., Swatch, Starbucks) or the other way around (e.g., Body Shop). Several have defied established views of who their customer is. Bloomsbury, for example, became one of the leading and most profitable information providers in the world by shifting their focus from IT managers who had traditionally purchased their financial information systems to the traders using them (Kim and Mauborgne, 1999). And finally, many firms have created new value through environment-friendlier or healthier products. For instance, Interface, the world’s leading commercial carpet manufacturer, has even embedded its range of environment friendly products in an innovative system of comprehensive flooring and facility solutions for commercial interiors, aligned with its comprehensive model for corporate sustainability (cf. Anderson, 1998).

In sum, the management of new value potentials reverts to different, but also more powerful levers of control than the management of extant value potentials. This includes changing established patterns, and rethinking and redesigning business systems.

Meanwhile, knowledge about the conceptual basis and the referents of normative management has also improved. The research that has led to this is primarily based on systems theory and cybernetics. It once more presents independent criteria—in this case, for the assessment of the viability and development of an organization. Note that this assessment is possible even if the specifics of the other two levels are not known! *Viability*, understood as the ability to maintain a separate existence (Beer, 1979), i.e., a distinct configuration that makes a system identifiable, can be assessed on the grounds of structural considerations that are not bound by the orientators of the strategic and operational levels.

To date, the most advanced theory for assessing the viability of an organization in functional terms is Stafford Beer’s Viable System Model (VSM), which will be outlined in the next section. This model is an excellent device for diagnosing the degree of viability of an organization, and for designing it to be viable, as well as independent of the steering criteria of the lower levels (strategic and operative).

As far as the “soft factors” of organization are concerned—referred to under the common denominator of “culture”—some models have been elaborated that for the time being appear more appropriate for description and diagnosis than for

design purposes (e.g., Deal and Kennedy, 1982; Schein, 1985). Beyond this, the emerging paradigms of the “learning organization” (cf. Argyris and Schön, 1978; Senge, 1992) and of the “knowledge organization” (cf. Nonaka and Takeuchi, 1995) are about to outline a developmental and transformative orientation to structure as well as to culture.

The ultimate goal of an organization is not its ability to survive. From a systemic point of view, it should aim at a *viability beyond survival* (cf. Schwaninger, 1993), i.e., a viability that transcends mere maintenance of a specific identity. Therefore, in Fig. 3, *development* has been distinguished as a higher goal in its own right. If development is defined as a system’s growing ability and desire to fulfil its own and others needs (after Ackoff, 1994), then a fundamental transformation of the organization becomes an imperative once this goal can no longer be achieved within the given identity or structure (in cybernetic terms: ... if it cannot provide a net benefit to external stakeholders (customers, society) anymore in its actual configuration). The relevance of this conjecture is corroborated by the growing rate of structural, economic, and juridical transformations of companies, with the aim of creating new viable organizational entities.

Social systems theories provide important insights for the diagnosis of a system’s propensity for development. This can be assessed as a function of its ethos (e.g., openness) and the pattern of its trajectories or dynamics¹¹. Criteria such as catalytic reinforcement, instability, consensus, self-governance, and learning help to judge whether a change process qualifies as “development” (as defined previously) or not (cf. Etzioni, 1968; Jantsch and Waddington, 1976).

The field of indicators at the normative level is multifaceted; social, political, cultural, and ecological aspects have to be considered. Adequate space must be given to ethical and aesthetical concerns for the pursuit of ideals such as beauty, truth, good, and plenty (cf. Ackoff, 1981). Multiple constituents ascribe different purposes to a social system, which leads to an emphasis on different criteria of fitness. For a corporation to be viable in the long run, the legitimate claims of these different stakeholders must be met adequately (cf. Kotter and Heskett, 1992).

The pre-control aspect in this context is that an organization with a relatively high level of viability/development should in principle have a relatively high likelihood of creating value potentials over time. Figure 4 contains a more general scheme, which is more comprehensive than the one in Fig. 3¹². It is also applicable to public organizations and to the social domain.

¹¹ The term *system dynamics* in Figs. 3 and 4 is used in a general way here. It is not confined to Forrester’s methodology of System Dynamics, albeit the same can be most useful to model a multilevel control system along the lines of the MSC (cf. Forrester, 1985; Schwaninger, 1997b).

¹² In particular, at the operative level, value is conceived in a multidimensional mode, including aspects of customer, financial, social, and ecological benefits.

4.1.2. Figure 4: Goals and Orientators at Different Logical Levels of Management (Generalized Version)

The feedback loop from lower to higher referents (Figs. 3 and 4) signifies at least two aspects: (a) lower level outcomes (e.g., liquidity, profit) impinge on the higher level referents insofar as they can further or restrain the respective goals; and (b) changes in operations (e.g., subcontracting), and ecological or social stakes may result in changes in inherent or control risk

At the three logical levels of management, different criteria of organizational fitness, or to speak more generally, systemic effectiveness, apply:

1. At the operative level, the criterion is *efficiency*, in terms such as productivity, quality, and profitability.
2. At the strategic level, it is *effectiveness* in both the cooperative and the competitive sense (the best is being unique, which I define as having no competitors at all).
3. At the normative level, it is *legitimacy*, defined as the ability to fulfil the claims of all relevant stakeholders.

Efficiency is very much an inward-looking goal; it adjusts the functioning of the system to criteria established on higher logical levels. The degree of this adjustment can be measured consecutively in terms of the benefits provided through ongoing activities, or, as Jan Carlzon (1987), former CEO of SAS¹³ put it, at the “moments of truth”:

- with the customer, via products and services (“customer value”)
- with the “owners,” via financial value (“shareholder value,” dividends, etc.)
- with employees, via monetary and nonmonetary benefits (pay, qualification, etc.)
- with society, via social benefit (employment, taxes, etc.)
- with society and future generations, via ecological benefits sustaining or even “restoring” the environment¹⁴.

The strategic referents as outlined in Figs. 3 and 4 link the internal perspective with the needs of the external environment—the market in the first place. The shorthand distinction between efficiency as “doing things right” and effectiveness as “doing the right things”¹⁵ is not perfect, but it does convey insightful metaphors, and is therefore used in Fig. 4. *Effectiveness* is a measure of the longer-term adaptation to these needs, and it can be measured by indicators that

¹³Scandinavian Airline System.

¹⁴The concept of *restorative ecological management* was coined by Ray Anderson, chairman of the Interface Group (Anderson, 1998).

¹⁵These definitions go back to Peter F. Drucker, the eminent thinker on management (cf. Drucker, 1977).

reflects such aspects as market position, critical success factors, core competencies, and innovation. These are often fuzzier measures, but their assessment can be accomplished as systematically as that of operational variables given the advanced state of the theory of strategic management.

Finally, the criterion of *legitimacy* used at the level of normative management relates the organization to its sociocultural context, and brings to the fore the role of multiple stakeholders. It is even compatible with those stakeholder-oriented frameworks that define an organization as a system of multiple constituents, therewith internalizing, in a sense, stakeholders who were traditionally conceived as external (e.g., Mitroff, 1983).

Intelligent organizations distinguish themselves from others by meeting all three criteria to a high degree. They are led in such a way that the control variables of all three logical levels are kept under control despite the contradictions that may occur between them. Only a model of integral management can dissolve such contradictions. It is my consistent experience that this conceptual scheme is very helpful (a) in over-coming conflicts in matters of leadership, and (b) in building better simulation and optimization models.

The following section will focus on the structural implications of the reflections made thus far. I shall expose the principles of design upon which the viability and development of an organization is based.

4.2. The Viable System Model

The intelligence of an organization manifests itself in behavior as outlined previously, but is dependent on structural prerequisites that enable and generate such behavior. Organizational Cybernetics conceives the task of management in terms of coping with high variety. The preceding section of this paper dealt with the control parameters required to manage complexity. This then begs the question of how an organization must be structured to make its (self-) control and (self-) development possible. Stafford Beer, the founder of Management Cybernetics, offers a model for this purpose: a set-theoretic model (Beer, 1962), in which he defined the organizational prerequisites for the viability of systems, was later operationalized in a topological model known as the *VSM-Viable Systems Model* (Beer, 1979; 1981; 1985). In this model, a set of functions is distinguished that provides the “necessary and sufficient conditions” (Beer, *passim*) for the viability of any human or social system (Fig. 5). These functions and their interrelationships are specified in a comprehensive theory, the propositions of which can be summarized as follows:

1. An enterprise is viable if and only if it disposes of a set of management functions with a specific set of interrelationships, identified and formalized in the model:

- System 5: Balancing present and future as well as internal and external perspectives; moderation of the interaction between Systems 3 and 4; ascertaining the identity of the organization and its role in its environment; embodiment of supreme values, rules and norms—the ethos of the system (normative management).

Systems 1-2-3 (including 3*) constitute operative management, System 4 (in interaction with System 3) strategic management, and System 5 the normative management of the organization.

4.2.1. *Figure 5: The Viable System Model—Overview*¹⁶

In this structure, the primary units (basic units with the regulatory capacity supplied by System 1) must dispose of high autonomy to be able to adapt to their respective environment or milieu. The combined activities of Systems 1, 2, and 3 (including 3*) provide for management of the present and short term. System 4 is the fulcrum for long-term adaptation, and System 5 the embodiment of the ethos—the basic principles and values governing the orientation of the organization as a whole.

2. Any deficiencies in this system, such as missing functions, insufficient capacity of the functions, or faulty communications or interactions between them, impair or jeopardize the viability of the organization.
3. The viability, cohesion, and self-organization of an enterprise depend upon these functions being recursively present at all levels of organization. This is illustrated in Fig. 6 by means of the example of a group of enterprises with four recursion levels.

4.2.2. *Figure 5: Recursive Structure of a Viable Organization (After Beer, 1979)*

A recursive structure comprises autonomous units within autonomous units. Moreover, a viable organization is made up of viable units, and it is itself embedded in more comprehensive viable units. Each unit, inasmuch as it is producing the organization's task rather than just servicing or supporting it, replicates—in structural terms—the totality in which it is embedded. In other words, it has all the functions outlined under (1.), to be able to manage, from start to finish, the processes for the purpose of which it exists. If we take such a viable organization as a “system-in-focus,” depending on the perspective adopted, it “may have more than one next higher and next lower recursion” (Beer, 1985).

In other words, the recursion principle is multidimensional. One and the same organization or organizational unit can function simultaneously both as a subsystem and a supersystem within the framework of different recursive orga-

¹⁶This is a slightly adapted version. For the full-fledged original, please see Beer (1985, p. 136) and Beer (1979; 1981).

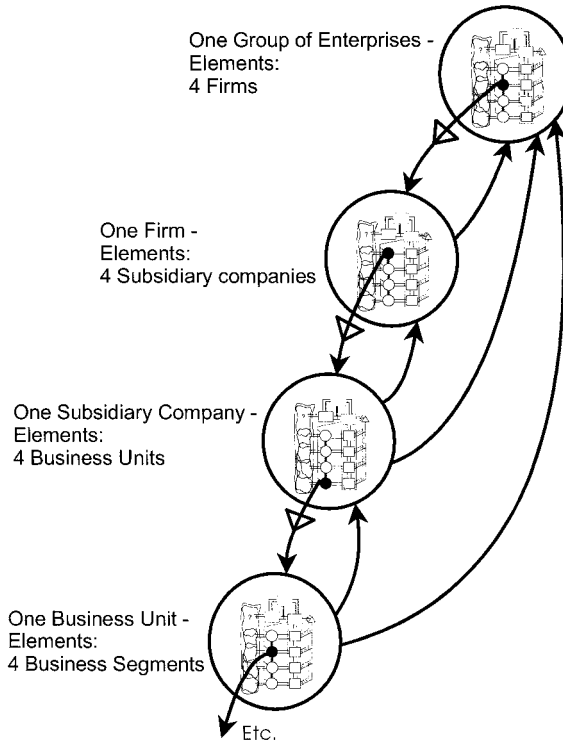


Fig. 6. Recursive structure of a viable organization (after Beer, 1979).

nizational configurations (cf. Fig. 7). Not only can it “function” in this way, but it can also be conceived or can perceive itself in this fashion. A simple example illustrating this point is an enterprise that is a part of a concern and is itself composed of several divisions (recursion A in Fig. 7). In order to cope with an ecological challenge, the firm in focus joins other enterprises to form a suitable association (recursion B). Additionally, this enterprise is a member of a consortium for research and development (recursion C). It is possible to conceive of other recursions. A recursion D, for example, can be introduced in the form of companies in which the enterprise has a share to keep the enterprise close to innovative developments in its areas of interests. For a pertinent application, see Leonard (1989). Finally, recursions do not necessarily run “from top to bottom;” they can also be circular. In other words, recursive and heterarchical relationships are compatible, as has been shown elsewhere (Schwaninger, 1996; forthcoming).

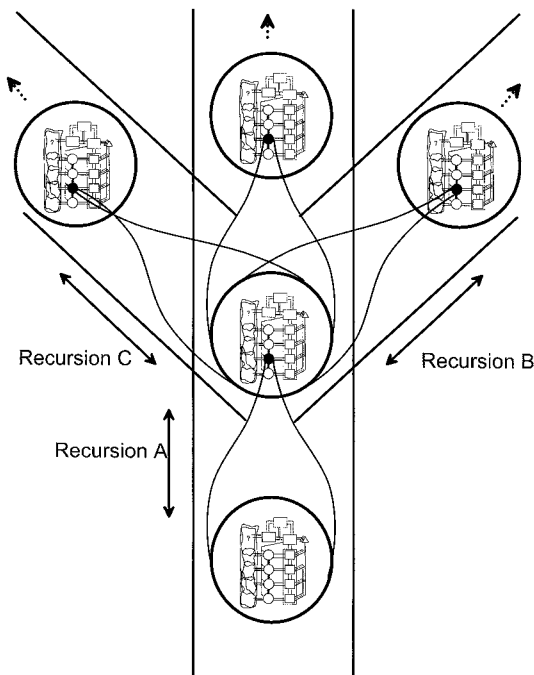


Fig. 7. The concept of recursion is multidimensional.

4.2.3. *Figure 7: The Concept of Recursion Is Multidimensional*

According to the VSM, all three levels of management—operative, strategic, and normative—are distributed functions, with aspects such as control, intelligence, and ethos being properties of the system as a whole, and inherent in all levels of recursion. This contradicts the often-repeated comments that “vision is the concern of the entrepreneur,” or “strategy is the duty of the board of directors.” Vision is a function of the metasystem: to be precise, it is one of the functions of the normative management of every viable unit. Strategic thinking is necessary even in the smallest units, if such units are conceived as viable wholes.

That is the reason why “metasystems” have to turn to orientators other than those of the corresponding “systems.” In small units, it is often the case that the same person undertakes the operational, strategic, and normative functions of management, as well as the basic activities of the organization. Despite this, it is vital for any unit in focus not to restrict itself to the operating functions (always with the assumption that the unit concerned is supposed to be viable). Such a system must be led so that the control variables at all the three levels

are taken into consideration and simultaneously kept under control. This holds true even when contradictions arise between these control variables.

At this point, the *Model of Systemic Control* and the *Viable System Model* can be tied together: it is incumbent upon the management at each recursion level to define for its purposes the specific orientators in a level-appropriate manner, and to realize a correspondingly “integral” leadership. Figure 8 illustrates this aspect, which is a key to *recursive management*. Starting from the model in Fig. 4, a scheme of the regulatory variables and orientators is presented in terms of examples for three recursion levels consisting of an enterprise, a subsidiary company, and a business unit.

4.2.4. *Figure 8: Operative, Strategic, and Normative Management as Distributed Functions*

The dotted line illustrates the point that for a given unit, information about units at recursion levels, other than those in the immediate neighborhood, can be of relevance. This line also indicates that, in principle, the logic of the presentation can be transferred to further recursion levels, and holds good for other structured, more complex networks.

The same logic also applies to “virtual organizations.” In principle, a virtual organization (from “virtus” meaning virtue) is capable of manifesting its potential through the most diverse variants. This would mean, for example, that from available resources, project teams are formed in many different constellations, and are tailor-made according to the task that needs to be accomplished. With this definition, the meaning of the word “available” can be expanded almost indefinitely. What is not available “inhouse” can be acquired through partnerships and cooperation. The goals of “viability” and “development” are also meaningful in these contexts. Even projects with a limited lifespan need a specific identity for the duration of their existence. Looking at the situation from the inside, the question “What is to become of us when the project is completed?” can be of significant concern for the members of the project team. Therefore, the system of regulatory variables for an integral management illustrated in Fig. 8 can also be transferred to the project level (cf. Schwaninger, 1996). A more detailed account of recursive management, and an underlying cybernetic theory of human action in organizations is given in Espejo, Schwaninger, and Schuhmann (1996).

The Viable System Model has been transduced into the language of business and applied to organizations of all kinds, as documented in several books (e.g., Espejo and Harnden (1989), Espejo and Schwaninger (1993), Espejo, Schuhmann, and Schwaninger (1996), and on a CD-ROM edited as a festschrift for Stafford Beer (Espejo and Schwaninger, 1998). It has been used in the design of national government (Beer, 1989) and public institutions. One of my doctoral candidates has based a diagnosis of the Swiss democracy on the VSM, and discerned important insights (Willemssen, 1992).

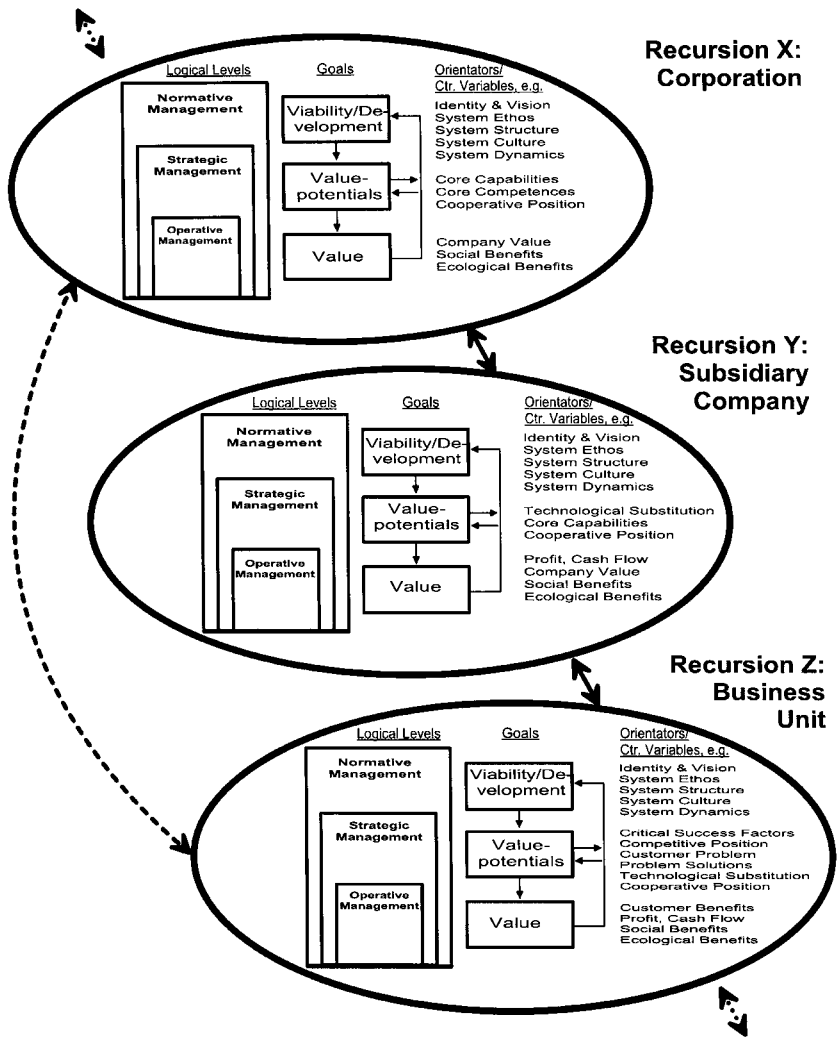


Fig. 8. Operative, strategic, and normative management as distributed functions.

4.3. The Team Syntegrity Model

The two models outlined previously address the issues of control and design. The *Team Syntegrity model (TSM)* is a structural framework to foster cohesion and synergy in larger groups of individuals, or to encourage the transformation of mere aggregates of individuals with similar interests into organizations with their own identities. Invented by Stafford Beer (1994),

TSM is a futuristic design for democratic management in the sense of the heterarchical-participative type of organization (cf, Schwaninger, 1996). The TSM is a holographic model for organizing processes of communication in a nonhierarchical fashion that can be shown to be mathematically optimal for the (self-) management of social systems. Based on the *structure of polyhedra*, it is especially suitable for realizing team-oriented structures, and for supporting processes of planning, knowledge generation, and innovation in turbulent environments. In the following, I shall illustrate the architecture of the model by using the geometry of an *icosahedron*, which is one of the structures commonly used to organize synte-gration events—in this case with 30 participants.

The formation of networks by persons who are connected by mutual interests is a manifestation of the information/knowledge society and a structural answer to challenges of our time. An *infoset* is a set of individuals who share a common concern, are in possession of pertinent information or knowledge connected with the issues of concern, and who have the will (and most likely also the enthusiasm) to tackle these. The *Team Syntegrity model* supplies the structural framework for the synergetic interaction of an infoset, which is intended to lead to an integration of multiple topics and perspectives toward a shared body of knowledge. The term *Syntegrity* results from a combination of *synergy* and *tensile integrity*. Synergy is the case in which the interaction or cooperation of two or more agents produces a combined effect greater than the sum of their individual efforts. Tensile integrity is the structural strength provided by tension, as opposed to compression (Fuller and Applewhite 1982).

An infoset of 30 persons, for example, can organize itself according to the structure of an icosahedron, the most complex of the regular, convex polyhedra (Fig. 9), whereas for smaller numbers of people, meeting structures based on other polyhedra are possible. Each member of a 30-member infoset is represented by one edge on the icosahedron. Each vertex stands for a team of five players (→ five edges) working on one topic; in an icosahedron, there are 12 vertices that would be marked by different colours in a Synte-gration. Therefore, given the geometry, each participant as a player/actor is connected by his/her edge to two different teams. Ms. *Red–Yellow*, for instance, belongs to the teams (vertices) *Red* and *Yellow*. At the same time, she is acting as a critic to two other teams (for example, *Black* and *Silver*, which are next neighbors). This means that each team consists of five players and five critics. Altogether, the 30 agents fulfill a total of 120 roles (30 times two roles as a player and two as a critic)¹⁷.

4.3.1. Figure 9: Icosahedral Structure of the Team Syntegrity Model

This structure dissolves the paradox of peripherality versus centrality of actors in an organization (as formalized by Bavelas, 1952): whereas peripherality leads to communication pathologies, alienation and low morale, centrality

¹⁷In addition, there is the observer role, on which I shall not expand here (cf. Beer, 1994).

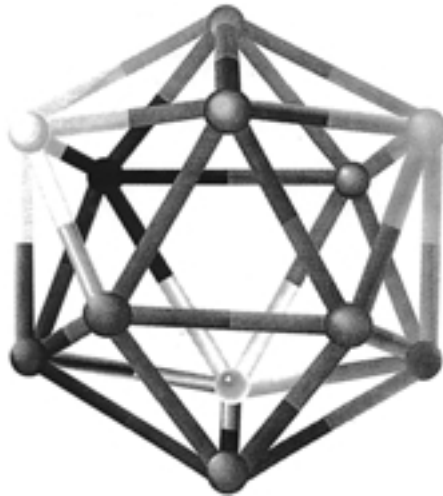


Fig. 9. Icosahedral structure of the Team Syntegrity model.

is needed for effective action. However, as a group grows, centrality can only be “bought” at the cost of increasing peripherality (Leonard, 1994). Team Syntegrity enables an Infoset to acquire “centrality” via a reverberative process (each team will meet more than once), although the peripherality of each one of its members equals zero, i.e., there is no peripherality at all.

A process of a syntegration has the following phases (This is a simplified description):

1. **Opening:** The syntegration is dedicated to a general topic that focuses all mutual efforts, and is explicated by an opening question. In syntegrations undertaken with students at the University of St. Gallen, the question was “How should management education be designed in the future?”
2. **Generation of the agenda (“Problem Jostle”):** Each participant hands in a contribution that seems important to him or her (Statements of Importance). In the following steps, these are discussed and combined (Aggregated Statements of Importance). Then, in a process of successive synthesis through discussion and voting, an agenda for the actual work on the general topic is generated (Hexadic Reduction). This is finally expressed in 12 topics (Consolidated Statements of Importance).
3. **Assignment to groups (“Topic Auction”):** Each member of the infoset ranks all 12 topics on a preference form. These are entered into the computer and the membership to a topic is assigned by an optimization algorithm. An alternative method would be to randomly assign membership to the edges linking the vertices of the polyhedron (i.e., topics).

4. **Working on the topics (“Outcome Resolve”):** The individual teams (consisting of five players and five critics each) explore their respective topic. Each team meets several times (usually in three iterations), and writes up a summary of its results to share with the whole infoset. The fact that the same issue, with its different but interconnected aspects, is continually processed by the same set of people who gather in alternating compositions (topic teams) implies strong reverberation and leads to a self-organizing process with high levels of knowledge integration. There is no center required to integrate the individual efforts; integration just happens “by itself.” It can be shown mathematically that this is a geometrically ergodic process, in which the eigenvalue¹⁸ of the process converges to a minimum: ninety percent of the information in the system will be shared after three iterations, and 96% after four iterations (Jalali, 1994, p. 277).
5. **Finalization:** Each team presents its conclusions in a plenary session. Planning for subsequent action or other final coordination may be added as necessary. Despite its young age, Team Syntegrity has been employed in over a hundred syntegegration events. Examples of its application to various concerns are given herein.
 - planning processes in universities, a polytechnical institute, and a hospital
 - organizational change in two Swiss banks
 - Strategic management in several industrial firms
 - governmental agencies in Canada
 - regional and community planning
 - nonprofit organizations
 - reorganization of a political organization in Great Britain
 - preparations for peace negotiations
 - seminars and workshops with students and researchers

Between 1995 and 1996, the first electronic syntegegration of an infoset distributed over the world was undertaken. A group of 30 cyberneticians from 16 countries and four continents engaged in distributed interaction (mostly via Worldwide Web and electronic mail), with a local syntegegration in England, midway in the process to produce a festschrift for Stafford Beer (for a detailed account, cf. Schwaninger, 1997a; 1999). The outcome of this process—an electronic “book”—has been published recently on a CD-ROM (Espejo and Schwaninger, 1998). This application is a first illustration of the potential of TSM to create new organizational forms. In this case, a new protocol for the development of a knowledge-intensive product in a distributed setting was developed. At this stage, it appears difficult to imagine a more efficient means by which 30

¹⁸ The formula to calculate the eigenvalue is: $y = (1/\sqrt[n]{5})^n$, with n denoting the number of iterations.

authors from different parts of the world who are writing a book together can produce a coherent and fully integrated body of knowledge in under a year (the details of the process are also documented in Schwaninger and Espejo, 1998).

At present, there seems to be no other model as equally powerful in systematically fostering deep involvement, self-organization, and the emergence of collective consciousness of large numbers of people¹⁹. The syntegrity process entails a tight network of communications and thereby helps to build relationships. Sociometric studies have ascertained significant increases in different measures of the cohesion of infosets from the onset to completion of the respective syntegegration events (cf. Schwaninger et al., 1995; Espejo and Schwaninger, 1998). Exploratory investigations of a hermeneutic rather than a statistical type also suggest that the conceptual mental models of participants are enriched as the process evolves. Further analyses have highlighted the phenomena of reverberation, self-organization, and self-reference in syntegegration events (Beer, 1994; Espejo and Schwaninger, 1998).

Team Syntegrity is certainly not the model to be applied to all kinds of group situations. As has been said, it is directed to large groups. It is also not indicated for standardized or routine problems. On the contrary, its strengths are in dealing with complex issues or ill-defined problems that require knowledge of different kinds or disciplines. Many of the applications enumerated in the preceding text were in the realms of strategic and normative management, and resulted in a high degree of knowledge conversion or knowledge generation. Many of the syntegegrations observed have shown processes of knowledge conversion (cf. Nonaka and Takeuchi, 1995), in particular

- (a) processes of externalization, i.e., conversion from tacit to explicit knowledge, as the conversation proceeded
- (b) processes of combination, i.e., exchanging and combining of different knowledge components contributed by different members of the infoset
- (c) processes of socialization, i.e., engaging in joint experience, thereby creating shared mental models (i.e., tacit knowledge), and mutual trust, which are critical for effective collaborative action

As tacit and explicit knowledge interact, for which syntegegrations provide ample opportunity, the creation of new knowledge becomes possible and innovations can emerge (*ibidem*). The strategy syntegegrations realized up to now have shown many cases in point, although these have not yet been explored comprehensively. Also, the instances in which repeated syntegegrations have been realized, are not frequent enough for solid conclusions to be drawn. It may, however, be assumed that ongoing or repeated syntegegrations would be a useful mode

¹⁹Comparative studies assessing the degrees of effectiveness of different methodologies for communication and interaction in large groups are still to be realized.

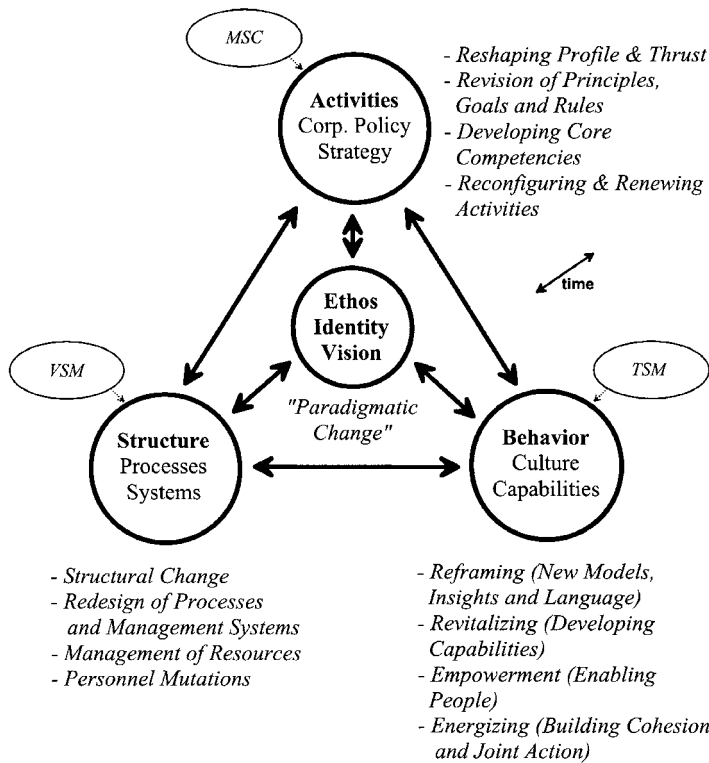


Fig. 10. A Framework for Intelligent Organizations.

of organizing the continuous dialogue on strategic issues (in the homeostat of Systems 3 and 4, in terms of the VSM). The Stafford Beer festschrift project mentioned earlier was an ongoing syntegegration with a duration of one year, with only one local syntegegration, preceded and followed by 5 to 6 months of electronic syntegegration. The success of that project suggests that similar applications would be worthwhile.

4.4. Toward a Framework for Intelligent Organizations

At this point, an attempt can be made to link the three models outlined by means of a coherent framework, which I call "Framework for Intelligent Organizations" (Fig. 10²⁰).

²⁰ An earlier version of this framework was elaborated in Schwaninger (1995) and published in Espejo et al. (1996). It built on earlier works in the context of the St. Gallen Management Concept (cf. Krieg, 1985; Bleicher, 1991).

This framework builds on several notions of systemic management:

1. The framework is *integrative*—in what respect? In contrast with many “frameworks” that emphasize partial aspects of organizations—e.g., strategy, structure, or organizational behavior—the emphasis in the one proposed here is on bringing together the different components so as to provide a more complete picture. Integration—the making up or composition of wholes—is a natural capability of humans largely based on unconscious inferences (cf. Gregory, 1987, p. 375). However, the complexity of real-world phenomena has made us prone to reductionism and fragmentation of our models²¹. The present framework is made up of a comprehensive set of “essential variables” (Ashby, 1965) and their identifiable interrelationships. Therewith, it does more than compile a list of important aspects; it is a frame of reference that is robust, broad enough, and sufficiently structured to enable actors to initiate and catalyze organizational development and transformation more effectively.
2. Management is conceived as a *multidimensional* process. In the scheme, four crucial dimensions are combined. Three of them—activities, structure and behavior²²—are the dimensions that make up the pillars of the “St. Gallen Management Concept,” which an architecture for structuring management issues developed at the University of St. Gallen (Bleicher, 1996)²³. The fourth dimension is fundamental parameters, such as organizational identity, ethos, and vision.
3. In logical terms, management is a *multilevel* process with
 - normative management fulfilling the foundational function, embodied by System 5 in the VSM
 - strategic management, the orientational function embodied by System 4 and the interrelationship between Systems 3 and 4 in the VSM
 - operative management, the function of realization embodied by Systems 1, 2, and 3 and their interrelationships in the VSM.
4. Management is a *recursive* process. In principle, the whole scheme applies to any level of recursion of an organization.

²¹For example, the empirical studies by Dorner (1997) and Reither (1997) have uncovered strong and recurrent tendencies of actors in complex systems to simplistic modeling of the situations faced, superficial analysis, and lack of validation, nonconsideration of side-effects, and overdosed, unbalanced interventions.

²²These categories are based on Ralph Gerard’s original scheme, with the dimensions of structure, function, and behavior as crucial characteristics of all kinds of living systems (cf. Rapoport, 1992, p. 17f.).

²³The “St. Gallen Management Concept” and its predecessor, the “St. Gallen Management Model” (Ulrich and Krieg, 1972) are frameworks that have orientated teaching and research in general management, at the University of St. Gallen for about three decades. They are rooted in the systems approach. This tradition has proven most valuable in accomplishing conceptual coherence and integration of a faculty jointly committed to building a strong management school.

5. The components that constitute the framework are *dynamically interrelated*.

A virtuous transformation leading to increasingly vigorous viability and adaptability requires synchronous development in all three domains—activities, structure, and behavior. The reflection and eventual development of the underlying “fundamental parameters” (such as identity, ethos, and vision) is an additional prerequisite of a higher order. Isolated, unidimensional or asynchronous changes are in principle less robust, and subject to failure more easily. The delicacy of managing a transformation is in part due to the fact that the time constants inherent in each one of these domains are different. Strategies can often be reinvented fairly quickly, whereas structural transformation takes more time, and the variables that react most slowly are the behavioral ones.

The three models outlined can facilitate and improve organizational transformation substantially, and even more so if they are used in an integrative and synchronized manner. The Model of Systemic Control supports an integral (self) control of *activities*. The Viable System model is a most powerful device for diagnosing and designing of *structure*. Finally, the Team Syntegrity Model provides a design for developing virtuous *behavior*—synergetic interactions, increase of cohesion, and the collaborative generation of knowledge, as well as the motivation for joint action in multiperson settings. However the utility of each one of these models is not limited to any one of these aspects. On the contrary, all three of them incorporate a systemic perspective, which implies also taking into consideration the other aspects. And each one has a substantial contribution to make with regard to reflecting fundamental issues such as ethos, identity, and the vision of an organization.

The inner logic that links the three models must now be made explicit, because it is at the core of an integration that leads beyond a merely eclectic combination of these or other models and methodologies:

- The MSC and the VSM are intrinsically related through a conceptual commonality, —the three logical levels of management—operative, strategic, and normative. Therefore they cohere naturally. For competent applications, it is necessary to understand these relationships thoroughly.
- TSM is complementary to the other two models. It was conceived as a methodology for the design of communications and interactions in the metasystem of organizations (Systems 3, 4, and 5 in terms of the VSM; in particular the homeostat of Systems 3 and 4). As the issues dealt with this level usually involve numbers of people that transcend those of conventional face-to-face-groups, it is necessary to use a methodology designed for large groups.

In this paper, I refrain from further theorizing about systemic integration,

but do try to shed some light on issues of a coherently combined application of the models outlined within the proposed framework. A follow-up paper will elaborate further on these conceptual aspects (Schwaninger, forthcoming).

4.5. On the Combined Use of the Models Outlined

To illustrate aspects of integrative change along the dimensions outlined in the proposed framework, and to visualize the different time dimensions involved, I shall refer to two corporate transformation projects. In both cases, I served as an external consultant and facilitator. The work was carried out internally by a team of executives, supported by a project manager and a “power promotor” (top executive or board member) in each case.

The first project involved a large insurance company, for which the strategy was completely reinvented (→ *activities*) and a structural transformation planned and prepared (→ *structure*) within 18 months. This work led ultimately to a new vision shared within the whole company, and had implications for its identity (→ *fundamental parameters*). An increasing knowledge and awareness of the superior competence the firm had in handling insurance and risk management issues for corporate customers, both internationally and globally, emerged in the group of executives carrying out the pioneering work.

The lengthy preparation period could have been compressed to 6 or 9 months. However, it was deemed prudent to take more time so that a new mind-set could emerge in the core group of 15 executives. This also allowed for greater interaction with their followers in order to build up confidence in the new model of the organization, and to coalign motivation to put it into practice (→ *behavior*). The consequent efficiency gain revealed itself when the company was completely reorganized from being a function-oriented organization to becoming a divisional organization. This was accomplished within less than 6 months, including the transformation of the whole IT infrastructure (→ *structure*). All of this happened without any significant resistance to change (→ *behavior*). Looking back at the project, it must be added that it took the new vision about 7 years to become an integral part of the culture of the organization, i.e., to become a “paradigm” (→ *identity, ethos, vision*). The original project goes back to the early 1980s, but the consequences of the organizational transformation have been palpable ever since. By the late 1990s, the respective company had become one of the most powerful players worldwide in the insurance and risk management business, with corporate customers at the international level.

The second case of a combined application of both MSC and VSM was a corporate development project in a private health organization, which had different features compared to the first case. In particular, it was smaller, but both corporate transformations were comprehensive, and shared a similar approach to the process. For an extensive report, see Schwaninger (1988). The most aston-

ishing phenomenon about this second case in point was that the joint work of the team on strategy and structure issues enabled the firm to continue unswervingly to realize its strategic investments, despite a serious decrease in sales and profits between years one and three of a 6-year monitoring period. The company went so far as to actualize the largest investments during a period in which, from an operative point of view, it was faring the worst. The fruits of this tremendous effort were long-term competitive superiority and sustained economic prosperity. This cannot be explained in terms of reshaped *activities* and *structure* only. The fulcrum of this amazing trajectory was consistent joint *behavior* of the management team, putting in practice their improved shared mental models grounded in a new sense of organizational *identity*.

In both cases outlined, the two models—MSC and VSM—were used to orientate the projects, but they were not yet combined with the TSM. However, teamwork was carried out in larger and smaller groups. This proved most valuable in terms of group learning, as evidenced in follow-up studies (Schwaninger 1988; 1989). In both cases, the core groups (about 15 persons, respectively) gathered in a number of workshops. In addition, the team members, in part supplemented by further knowledgeable individuals of the organization, engaged in smaller groups to tackle specific issues. Furthermore, in both cases, the internal project managers were pillars of strength at the behavioral level, providing extensive individual and human support all along the difficult path of the transformations.

Is there a link between the conceptual underpinnings of these projects and their positive results? It has been claimed by members of the core teams²⁴ that the positive effects can mainly be attributed to the conceptual guidance of an integrative framework with all four dimensions outlined, and the combined use of the reference models²⁵ for the process of organizational transformation. It cannot be proved, but there is substantial evidence from the follow-ups (*ibidem*) that this conceptual guidance was a major factor in enabling the virtuous processes of transformation and development of these two companies.

Ongoing action research will extend the empirical evidence given here. Reports drawing on experiences of other organizations, including applications of the TSM, are being prepared.

It must be added that some empirical work by other authors is relevant in this context. The first source is a publication by Pettigrew and Whipp (1993).

²⁴ Sources: Follow-up analysis of corporate data, as well as interviews realized 5 years after the original projects had been concluded (mostly published in Schwaninger, 1988), and later (unpublished to date).

²⁵ The concrete framework used in both cases described was a predecessor of the one finally proposed in the present paper. The models explicitly introduced in the workshops and applied together with the executives of the companies were the St. Gallen Management Model, the MSC, and the VSM.

These authors, on the basis of longitudinal, in-depth case studies, have identified the followingt “central factors” as conditions for successful corporate transformations:

- *Environmental assessment*: e.g., information processing as a multi-function activity, development of an understanding of the environment, becoming an open learning system
- *Leading change*: e.g., context-sensitive leadership, creating capability for change, linking action by people at all levels of the organization, construction of a climate for change
- *Linking strategic and operational change*: e.g., supplying visions, values, and direction, implementing intentions over time, cumulative, supportive activities at various levels
- *Human resources as assets and liabilities*: e.g., raising human resource management consciousness, demonstrating the need for business and people change, creating a longer-term learning process with successive positive spirals of development
- *Coherence*: e.g., consistency of goals, consonance by adaptive response to environment, maintenance of competitive advantage, feasibility of the strategy.

These factors represent all four dimensions of the framework, activities, structure, behavior, and fundamental parameters, albeit in slightly different terms.

The second source is an empirical inquiry into the success factors of complex projects undertaken in commercial firms (Rudolph, 1999). This study²⁶ supports the proposition that the performance of a methodology that consistently integrates crucial dimensions²⁷ is significantly superior to the performance of other project methodologies.

Both of these results are encouraging, insofar as they corroborate that the frame of reference presented here points in the right direction.

5. OUTLOOK

I have tried to demonstrate the enormous potential of the systems approach and pertinent tools for more effective dealing with high variety than by means of established disciplines or mere pragmatics. This does not disqualify disciplinary efforts in the important fields of economics, sociology, psychology etc., nor does it deny the wisdom of practitioners. Systems theory and cybernetics fur-

²⁶Method used: Causal Analysis with LISREL.

²⁷Dimensions measured were conceptual, behavioral, and structural (each operationalized by three indicators). Success was measured by three criteria (social success, economic success, and overall evaluation of success by department-head in charge).

nish crucial knowledge about invariant features of organizations. This can help managers, specialized scientists of the different disciplines, and all members of organizations to leverage their knowledge by making new sense of it through reaching a deeper understanding, and thereby serving the needs of organizations and society better.

Through a framework for the design of intelligent organizations, three models of organizational cybernetics have been linked for the purpose of fostering the intelligence of organizations: The Model for Systemic Control, the Viable System Model, and the Team Syntegrity model. The proposition of this paper is that a combined use of these models, guided by the suggested framework, enables a more effective response to complex situations than do merely pragmatic approaches to “integrative management.” Provisional empirical evidence gathered from applied research cannot prove this, but suggests that the proposed framework is capable of enhancing superior potential for effective response. Therefore, it promises to meet the needs, in particular, of the new types of organizations, which already have begun to emerge in the knowledge societies.

The models outlined here also help to enhance the connectivity of specialists from different domains by fusing their capabilities in joint efforts for organizational and sociocultural progress—not just in economic terms, but in a much broader sense. This will ultimately lead us beyond the technocratic, unidimensional, myopic, reductionist, and narrow-minded modes of management, which are still so often in use today. And it will breed a new kind of organization so urgently needed for ensuring a sustainable future.

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REFERENCES

- Ackoff, R. L. (1981). *Creating the Corporate Future*, John Wiley and Sons, New York.
- Ackoff, R. L. (1994). *The Democratic Corporation*, Oxford University Press, New York/Oxford.
- Anderson, R. C. (1998). *Mid-course Correction. Toward a Sustainable Enterprise: The Interface Model*, Chelsea Green Publishing, White River Junction, VT.
- Argyris, Ch. and Schön, D. A. (1978). *Organizational Learning: A Theory of Action Perspective*, Reading, Mass., Addison-Wesley.
- Ashby, W. R. (1956). *An Introduction to Cybernetics*, Chapman & Hall, London.
- Ashby, W. R. (1965). *Design for a Brain*, Chapman & Hall, London.
- Ashby, W. (1981). Analysis of the system to be modeled. In Conant, R., (ed.), *Mechanisms of Intelligence. Ross Ashby's Writings on Cybernetics*, Intersystems Publications, Seaside, CA, pp. 335–355.

- Bavelas, A. (1952). Communication patterns in problem groups. In *Cybernetics: Transactions of the Eighth Conference*, New York: Josiah Macy Jr. Foundation.
- Beer, S. (1962). Towards the cybernetic factory. Reprinted in: Harnden, R. and Leonard, A., (eds.), (1994). *How Many Grapes Went into the Wine*. Stafford Beer on the Art and Science of Holistic Management, John Wiley and Sons, Chichester.
- Beer, S. (1979). *The Heart of Enterprise*, John Wiley and Sons, Chichester.
- Beer, S. (1981). *Brain of the Firm*, 2nd edition, John Wiley and Sons, Chichester.
- Beer, S. (1985). *Diagnosing the System for Organizations*, John Wiley and Sons, Chichester.
- Beer, S. (1989). National Government: Disseminated Regulation in Real Time, or 'How to Run a Country'. In Espejo, R. and Harnden, R., (eds.), *The Viable System Model: Interpretations and Applications of Stafford Beer's VSM*, John Wiley and Sons, Chichester, pp. 333–360.
- Beer, S. (1994). *Beyond Dispute. The Invention of Team Syntegrity*, John Wiley and Sons, Chichester.
- Bleicher, K. (1996). *Das Konzept. Integriertes Management*, 4th edition, Campus, Frankfurt/New York (first edition 1991).
- Carlzon, Jan (1987). *Moments of Truth*, Ballinger, Cambridge, Mass.
- Conant, R. C., and Ashby, W. R. (1981). Every good regulator of a system must be a model of that system. In Conant, R. (ed.), *Mechanisms of Intelligence. Ashby's Writings on Cybernetics*, Intersystems Publications, Seaside, CA., pp. 205–214.
- Deal, T. E., and Kennedy, A. A. (1982). *Corporate Cultures. The Rites and Rituals of Corporate Life*, Addison-Wesley, Reading, Mass.
- Dorner, D. (1997). *The Logic of Failure: Recognizing and Avoiding Error in Complex Situations*, Addison-Wesley, Reading, Mass.
- Drucker, Peter F. (1977). *Management: Tasks, Responsibilities, Practices*, Harper's College Press, New York.
- Drucker, P. F. (1980). *Managing in Turbulent Times*, Heinemann, London.
- Drucker, P. F. (1999). Drucker on financial services. Innovate or die. *The Economist*, September 25th, pp. 27–34.
- Ellis, J., (1999). Customers desert to digital market. *International Herald Tribune*, April 1, p. 6.
- Espejo, R. (1989). The Viable system model revisited. In Espejo, R. and Harnden, R. (eds.), *The Viable System Model: Interpretations and Applications of Stafford Beer's VSM*, John Wiley and Sons, Chichester, pp. 77–100.
- Espejo, R., and Harnden, R., eds. (1989). *The Viable System Model. Interpretations and Applications of Stafford Beer's VSM*, John Wiley and Sons, Chichester.
- Espejo, R., Schuhmann, W., Schwaninger, M., and Bilello, U. (1996). *Organizational Transformation and Learning. A Cybernetic Approach to Management*, John Wiley and Sons, Chichester.
- Espejo, R., and Schwaninger, M., eds. (1993). *Organizational Fitness—Corporate Effectiveness through Management Cybernetics*, Campus Frankfurt/New York.
- Espejo, R., and Schwaninger, M., eds. (1998). *To Be and Not to Be, That is the System. A Tribute to Stafford Beer*, CD-ROM, Carl-Auer-Systeme-Verlag, Wiesbaden.
- Espejo, R., and Watt, J. (1988). Information management, organization and managerial effectiveness. *J Oper Res Soc*, **39**, 7–14.
- Etzioni, A. (1968). *The Active Society. A Theory of Societal and Political Processes*, Collier, MacMillan, London/New York.
- Forrester, J. W. (1985). *Industrial Dynamics*, MIT Press, Cambridge, Mass., 11th printing (originally published 1961).
- Fuller, R., Buckminster, X. X., and Applewhite, E. J. (1982). *Synergetics: Explorations in the Geometry of Thinking*, Macmillan/Collier, New York/London.
- Gälweiler, A. (1990). *Strategische Unternehmensführung*, 2nd edition, Campus, Frankfurt/New York.

- Gregory, R. L., ed. (1987). *The Oxford Companion to the Mind*, Oxford University Press, Oxford/New York.
- Jalali, A. (1994). Reverberating networks. Modelling information propagation in synte-gration by spectral analysis. In Beer, S. (ed.), *Beyond Dispute. The Invention of Team Syntegrity*, John Wiley and Sons, Chichester, pp. 263–281.
- Jantsch, E., and Waddington, C. H., (eds.) (1976). *Evolution and Consciousness: Human Systems in Transition* Addison-Wesley, Reading, Mass.
- Kim, W. Ch./Mauborgne, R. (1999). Creating new market space. *Harvard Business Review*, January-February, Vol. 77, Issue 1.
- Kotter, J./Heskett, J. (1992). *Corporate Culture and Performance*, Free Press, New York.
- Krieg, W. (1985). Management-und Unternehmungs-entwicklung-Bausteine eines integrierten Ansatzes. In Siegwart, H., Probst, xx, and Gilbert J. B. (eds.), *Integriertes Management*, Haupt, Bern/Stuttgart, pp. 261–277.
- Leonard, A. (1989). Application of the VSM to commercial broadcasting in the United States. In Espejo, R. and Harnden, R., (eds.), *The Viable System Model*, John Wiley and Sons, Chichester, pp. 176–209.
- Leonard, A. (1994). Team syntegrity: Planning for action in the next century. In Brady, B. and Peeno, L., (eds.), *Proceedings, Conference of the International Society for the Systems Sciences*, Louisville, Kentucky, pp. 1065–1072.
- Mingers, J. and Gill, A. eds. (1997). *Multimethodology. The Theory and Practice of Combining Management Science Methodologies*, John Wiley and Sons, Chichester.
- Mitroff, I. I. (1983). *Stakeholders of the Organizational Mind*, Jossey Bass, San Francisco.
- Nonaka, I. and Takeuchi, H. (1995). *The Knowledge-Creating Company*, Oxford University Press, Oxford.
- Pettigrew, A. M., and Whipp, R. (1993). *Managing Change for Competitive Success*, Blackwell, Oxford.
- Rapoport, A. (1992). Weltbilder—Wissen und Glauben: Die systemische Sicht. In Weltbilder—Wissen und Glauben, *Aulavorträge*, Nr. 55, St. Gallen, Hochschule St. Gallen, pp. 3–27.
- Reither, F. (1997) *Komplexitätsmanagement. Denken und Handeln in komplexen Situationen*, Gerling Akademie Verlag, Munich.
- Rudolph, Th. (1999). *Marktorientiertes Management komplexer Projekte im Handel*, Schäffer-Poeschel, Stuttgart.
- Schein, E. H. (1985). *Organizational Culture and Leadership*, Jossey-Bass, San Francisco/London.
- Schwaninger, M. (1988). *Anwendung der integralen Unternehmungs-entwicklung. Beurteilung von Konzept und Methodik anhand einer Pilotstudie*, Haupt, Bern/Stuttgart.
- Schwaninger, M. (1989). *Integrale Unternehmungsplanung*, Campus, Frankfurt/New York.
- Schwaninger, M. (1993). A Concept of Organizational Fitness. In Espejo, R., and Schwaninger, M. (eds.), *Organizational Fitness—Corporate Effectiveness through Management Cybernetics*, Campus, Frankfurt/New York: Campus, pp. 39–66.
- Schwaninger, M. (1995). *Enabling Systemic Management*, Working Paper, Institute of Management at the University of St. Gallen (published as part of Espejo et al., 1996).
- Schwaninger, M. (1996). *Structures for Intelligent Organizations*, Discussion Paper, Institute of Management, University of St. Gallen, No. 20.
- Schwaninger, M. (1997a). Global Transdisciplinary Research Co-operation: Thirty Cyberneticians Online. *Kybernetes*, 26, pp. 459–463.
- Schwaninger, M. (1997b). The dynamics of environmental responsibility in management. In Barlas, Y., Dikat, V. G., and Polat, S., (eds.), *15th International System Dynamics Conference, Proceedings*, Bogaziçi University, Istanbul, Turkey.
- Schwaninger, M. (1998). Anatol Rapoport, *ISSS-International Society for the Systems Sciences*, homepage, “luminaries” section—<http://www.issss.org/lumrapo>.

- Schwaninger, M. (1999). Self-organization and self-reference in the cognition of organizations. In Braitenberg, V., and Radermacher, F.-J., (eds.), *Interdisciplinary Approaches to a New Understanding of Cognition and Consciousness*, Universitaets-Verlag, Ulm.
- Schwaninger, M., Hechenblaickner, P., Krafft, A., and Steiner, S. (1995). *Research Report on the "Kingview Syntegration,"* July 17–20, Toronto, Canada, and St. Gallen, University of St. Gallen.
- Senge, P. M. (1992). *The Fifth Discipline. The Art and Practice of the Learning Organization*, Century Business, London.
- Sternberg, R. J. (1987). Intelligence. In Gregory, R. L., (ed.), *The Oxford Companion to the Mind*, Oxford University Press, Oxford/New York, pp. 375–379.
- Ulrich, H. (1984). *Management*. Campus, Bern/Stuttgart.
- Ulrich, H., and Krieg, W. (1972). *St. Galler Management-Modell*, Haupt, Bern.
- Willemsen, M. H. (1992). *Die Schweizerische Eidgenossenschaft als lebensfähiges System. Kybernetische Analyse des schweizerischen politischen Systems*, Dissertation Nr. 1314, Hochschule St. Gallen, St. Gallen, Switzerland.