Mastering Complexity and Changes in Projects, Economy, and Society via Project Management Second Order (PM-2)

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ABSTRACT ■

Project Management Second Order (PM-2) is based on new insights in modern natural and social sciences, which were analyzed in a research program. This was explained in a previously published article in this journal (Saynisch, 2010). PM-2 is a new paradigm and will be the leading concept for the next decades. The concept of PM-2 was awarded the IPMA Research Award 2007 and the International Centre for Complex Project Management Research Prize 2010. The model represents a reference model. This article will explain the genesis of PM-2 as well as the principles, methods, and processes. Further, practical use will be discussed and real examples of transfer will be shown as well as PM-2 in the context of project-oriented companies. Integration aspects of CPMCS (ICCPM), ICB3 (IPMA), *PMBOK® Guide/OPM3®* (PMI) as a future view will be shown.

KEYWORDS: advanced project management; traditional project management; complex project management; complex projects; evolutionary management; evolutionary acquisition; self-organization; Project Management First and Second Order; Cybernetics First and Second Order; agile project management

The Challenge for an Advanced Understanding of Project Management

The new challenges and possibilities leading to a new understanding of project management are presented in Figure 1. Our world and society, with their markets, people, and organizations, do not develop in a predictable way (continuous, stable, linear), but unpredictably (discontinuous, unstable, nonlinear). This is situated in a crucial phase with totally new challenges, leading to an increased complexity (Figure 1, top left).

Parallel to these changes, a rapid growth of complex new technologies and innovations in industrial and social products can be seen (Figure 1, top right)—for example, micro- and biosystems, nanotechnology, and biological or living systems (particularly human-social systems or gene technology) (Saynisch, 1997, 2002). Highly complex situations that need to be mastered by management are the result (Figure 1, center). Traditional methods lose their efficiency to master this.

The keys to a new management understanding are new insights and perceptions in natural and social science (evolutionary and chaos theory, self-organization, synergetic, brain research, social systems theory, theory of complex systems, etc.), offering to strike a new path for project management (Figure 1, bottom center). How can these theories be applied or put into practice in concrete projects? This was the task of the research program "Beyond Frontiers of Traditional Project Management" (Saynisch, 2003, 2004, 2005a; Saynisch & Lange, 2002).

These situations demand a cooperation of *systemic-evolutionary* (self-organizing) and *system-technological* (constructive) determined principles. Project Management Second Order (PM-2) meets these requirements (Saynisch, 1997, 2002, 2005a, 2005b).

PM-2 integrates the former traditional approach in project management (Project Management First Order) with the results of the research program "Beyond Frontiers of Traditional Project Management" (Saynisch, 2003, 2004; Saynisch & Lange, 2002). It is a reference model that is recommended for specific demands. Project Management Second Order is to be considered a future management system meeting the challenges and requirements of the third millennium.

The Research Program "Beyond Frontiers of Traditional Project Management"

On the research program, interdisciplinary study teams have been working under the direction of Manfred Saynisch on new cognitions, concepts, and recommendations for project management. World-class thinkers and scientists,
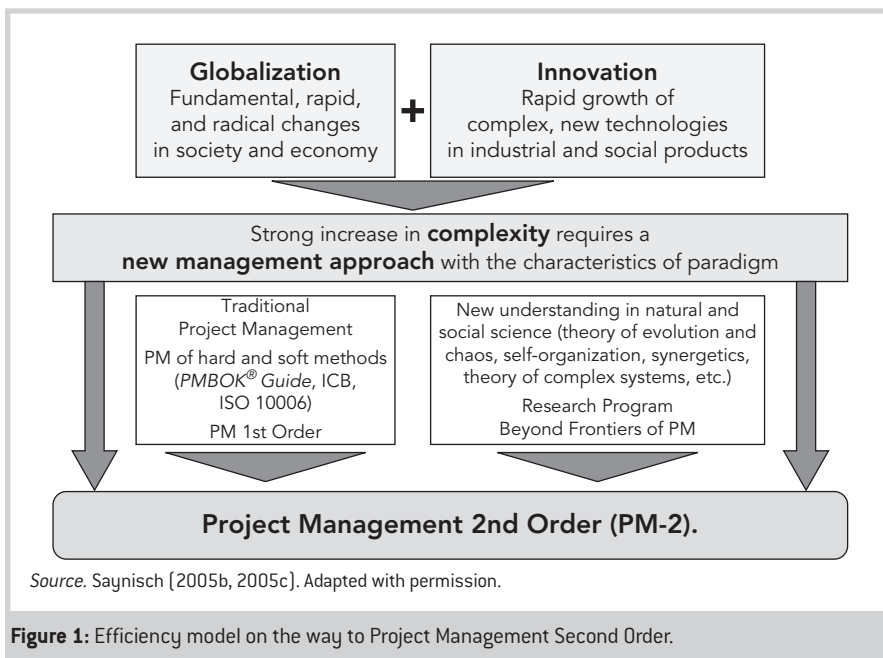
Source. Saynisch (2005b, 2005c). Adapted with permission.

Figure 1: Efficiency model on the way to Project Management Second Order.

such as Ervin Laszlo, especially with his theory of evolution, and Heinz von Foerster, with his Cybernetics Second Order, have acted as protagonists.

On this research program, we have for the new challenges analyzed a great deal of modern natural and social scientific theories with a focus on their relevance to project management. Although the great number of elaborated themes and their outcomes focalize to single phenomena of perceptions, characteristics, and possible actions, these particular results with their respective limited scope cannot configure a comprehensive holistic management system. Additionally, an umbrella function is necessary to link all these particular results in a systemic way. Therefore, we have developed the Project Management Second Order. As a highlighted result of the research program, PM-2 shows a *new paradigm*, but also new solutions to new challenges in project management. The concept of PM-2 was awarded the IPMA Research Award 2007 (International Project Management Association [IPMA], 2007; Steeger, 2007) and the ICCPM Research Prize 2010 (International Centre for Complex Project Management, www.iccpm.com).

The subjects and results of the research program (1990 until 2000) were extensively presented in a documentation book (Saynisch & Lange, 2002). Comprehensive descriptions are presented in several congress papers (Saynisch, 2003, 2005b, 2005c, 2007). Furthermore, this research program was explained and discussed in detail in a previously published article (Saynisch, 2010). As a new paradigm in project management, PM-2 meets the challenging and trend-setting requirements of Bredillet (2007) for a new perspective and approach in project management research. These requirements were based on inductive knowledge, qualitative paradigm, constructivist epistemology, speculative thoughts, nontraditional logic, and moving beyond the classical management perspective.

Limits of Traditional Project Management

Traditional management understanding is represented, for example, by the 12 Knowledge Areas described in the Project Management Institute's *A Guide to the Project Management Body of Knowledge (PMBOK® Guide)*—Fourth Edition (Project Management Institute [PMI],

2008a) and most elements of the IPMA Competence Baseline, Version 3.0 (ICB3, 2006) as well as ISO 10006 (International Organization for Standardization, 1997). It is based mainly on a mechanical, monocausal, nondynamic, linear structure and a discrete view of human nature and societies and their perceptions, knowledge, and actions. It works on the basis of reductionist thinking and on the Cartesian/Newtonian concept of causality (the mechanistic science). Traditional project management cannot solve these widespread profound challenges, described in the first section of this article. We will call this widespread traditional management understanding "Project Management First Order (PM-1)." (This was explained and discussed in detail in a previously published article in this journal [Saynisch, 2010].)

The Genesis of Project Managements to PM-2

The First Project Management Understanding—The Project Management of First Type and First Order

Project management has its origins in a concept that was developed in the United States at the end of the 1950s for large-scale undertakings and megaprojects in the aerospace and defense industries (Figure 2, top, left, and center). The implementation and application of this concept in other industry sectors (e.g., building, plant construction, and data processing, as well as in smaller-scale projects) has been a significant issue over the last four decades. Professional project management organizations, especially in the United States and Europe (e.g., PMI, IPMA, Deutsche Gesellschaft für Projektmanagement E.V. [GPM]), have devoted themselves to project management practices and have published guidelines and standards (the *PMBOK® Guide* [PMI, 2008a], ICB3 [IPMA, 2006], DIN standards [Lange & Bechler, 2005], and ISO 10006 [ISO, 1997]) in this respect. The focus is on the forward planning of specific approaches and action plans (e.g., planning

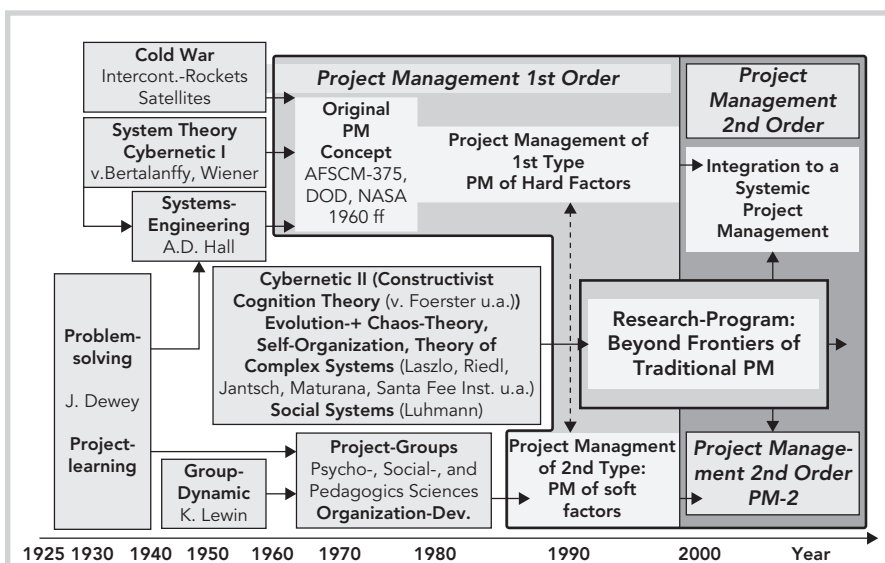# Mastering Complexity and Changes in Projects, Economy, and Society

Figure 2: The genesis of project management to PM-2 (Saynisch, 1995, 2002, 2005b).

phase, achievement of objectives). The approaches (Saynisch, 1995, 2002) consider the goal and object-oriented system (product) rather than the project participants. In recent years, these guidelines and standards have incorporated the "people" aspect of projects on the basis of organizational and HR development, described in the following section. In Figure 2, this is represented by the vertical dotted arrow.

The Second Project Management Understanding—The Project Management of Second Type and First Order

Since the 1980s, project management has additionally focused on the behavior of the human beings in organizations, mainly on the basis of organizational and HR development (Saynisch, 1995, 2002). This project management of the second type and first order (Figure 2, bottom center) is based on a behavior-oriented understanding of project management and takes "soft factors" such as human interaction and changes of attitude into account.

The Common Roots of First and Second Type

It is striking that both types of project management have the same origins

(Figure 2, left). The branched yet entirely separate roots spring from American philosopher and teacher J. D. Dewey, who developed his concepts in the first half of the nineteenth century. Dewey was also one of the few philosophers (in addition to Karl Marx) who dealt with Charles Darwin's evolution theory and incorporated some of Darwin's principles in his concepts. The initiator of systems engineering, A. D. Hall (1962), defined his systems engineering process on the basis of Dewey's problem-solving concept for human thought and action. The educational concept of learning in project groups and team dynamics is based on the work of Dewey and Kilpatrick in the 1920s (Dewey, 1938; Dewey & Kilpatrick, 1935; Saynisch, 1991, 1995, 2002).

Integration in a New and Systemic Concept of Project Management, PM-2

The research program "Beyond Frontiers of Traditional Project Management" analyzed (from 1990 onward) new perspectives and insights in the natural and social sciences, which paved the way for project management concepts (Figure 2, center). One significant finding of this research program was the development of a new

understanding of project management (Figure 2, right) as Project Management of the Second Order.

Research Results for the Basic Concept of PM-2

Literature Review

After a number of years of work in the research program, in 1997 there was a maturation of the insight that all of the preliminary findings since 1990 are not sufficient for building a new comprehensive system of project management. We have subsequently searched for the missing link, but have not found any suggestions in the literature. Therefore, we have "been on our own" in finding a solution, which will be presented in the next section of this article.

Only recently have papers on some closely related concepts been published. For example:
- the EPSRC Network's "Rethinking Project Management" (Winter, Smith, Cooke-Davies, & Cicmil, 2006);
- the PMI-funded research project "Exploring the Complexity of Projects: Implications of Complexity Theory on Project Management Practice" (Cicmil, Cooke-Davies, Crawford, & Richardson, 2009; Cooke-Davies, Cicmil, Crawford, & Richardson, 2007);
- the Complex Project Managers Competency Standard (CPMCS) (International Centre for Complex Project Management [ICCPM], 2008); and
- the project-oriented company— multiproject firms at the edge of chaos (Geraldi, 2008).

(We will discuss two of these papers later in this article.)

Need for Two Cybernetic Cycles of Control

PM-2 is a universal draft for *mastering complexity in projects* and project management. PM-2 assumes that traditional project management will furthermore play an active and important role. But this traditional approach has to be monumental, extended to a project

management that considers dynamic, nonlinear, and multicausal structures and processes, as well as principles of self-organization, evolution, and networking.

A project is a strongly goal-oriented system with a defined finishing point in time. Projects are determined by their goals. Evolutionary and self-organizational processes do not strive for conclusion at a defined point in time. Evolutionary/self-organizational processes are not determined by goals. They are processes without a specific destination. Therefore, evolutionary and self-organizational-based management methods cannot help to reach the fixed goal in a project.

For an effective attainment of project goals at the defined finishing point in time, we need the linear processes and the *Cartesian causality and the Newtonian logic* from traditional project management. But evolutionary and self-organizational-based management methods are necessary to master complex and uncertain situations on the way to the defined finishing point in time for a project. A well-balanced interaction of traditional project management and the evolutionary and self-organizational principles is the message of the Project Management Second Order.

PM-2 is the enabler for simultaneous, synchronous acting and usage of:
• high evolutionary dynamics, autopoietic or living systems, chaotic environment, self-organizational processes, and human-social systems; and
• processes for technical configuration, design, and realization (machine systems), with the features of clear calculability and planned forecasting.

The basic architecture and process model of PM-2 (Saynisch, 2005b, 2005c, 2008a, 2008b) is demonstrated in Figure 3. The horizontal time arrow in the center represents the processes of the project-product—the product processes. This arrow of time starts with the idea (start of a project) and ends with the project result, deliveries, or the real
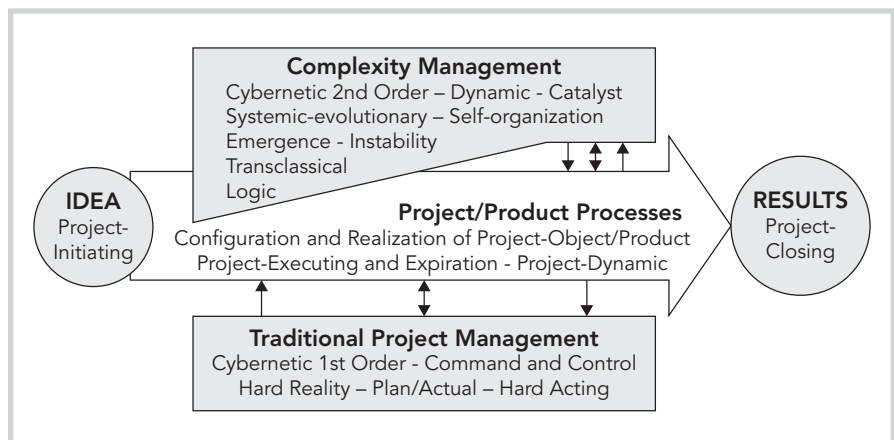

Figure 3: The basic architecture and process model of PM-2 (Saynisch, 2005b, 2005c, 2008b, 2008c).

product, the defined finishing point. Two cybernetic cycles navigate and directly control this project-process in an interactive, complementary, and cooperative sense.

In our research program, we have found, that for the differentiation of the traditional view of project management and the new complexity view, the following scientific approaches and theories with features of paradigm are most important factors:
• Cybernetics First Order vs. Cybernetics Second Order (von Foerster, 1981, 1994),
• classical logic vs. transclassical logic (Günther, 1976–1980),
• allopoiesis vs. autopoiesis (Maturana, 1982),
• order vs. edge of chaos, and
• Cartesian/Newtonian/Enlightenment vs. modern sciences (e.g., quantum theory, theory of evolution).

The First Cybernetic Cycle—
Traditional Project Management
The first cycle (named *World 1*) represents the traditional management approach. The term *World 1* is, in addition to the succeeding explanations, outlined in the section "The Creation of a Systemic Architecture and Process Model of PM-2."

The principle of *Cybernetics First Order* is the logic of this kind of control in World 1. That means an observer

(manager) acting *outside* of the system (von Foerster, 1981, 1994; Wiener, 1961). The observer (manager) monitors and checks the system and the project-product processes. He or she compares the monitoring results against planned data and intervenes if necessary from his or her outside position into the system. The small vertical arrows (information flow) symbolize this approach.

Classical logic (since Aristotle), or *bivalent logic*, acts as the decision basis (i.e., yes/no logic). Acting is determined by techniques and hard facts, based on the Cartesian/Newtonian/Enlightenment paradigm, the "mechanistic" sciences.

The Second Cybernetic Cycle—
Complexity Management
The other cycle (on top, in the following, named *World 2*) represents the monumental extension of traditional project management to the management of complexity. The term *World 2* is, in addition to the succeeding explanations, outlined in the section "The Creation of a Systemic Architecture and Process Model of PM-2."

World 2 considers dynamic, nonlinear, and multicausal structures and processes, as well as principles of self-organization, evolution, and networking. The principle of Cybernetics Second Order is largely the logic of this kind of control. That means an observer

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(manager) acting *inside* of the system (von Foerster, 1981, 1994). This represents the principle of "management in projects/complexity."

It is difficult to achieve a clear understanding of the important, but abstract cybernetic principle of "acting inside of the system" because professional blinkers have to be overcome! A good example for understanding the features of this principle is the concept of "complex responsive processes of relating (CRPR)" (Stacey, 2001). This concept is based in many thinks on principles of Cybernetics Second Order, while recognizing and acting inside of the system.

A significant part of control will take place inside of the system, in the project-product processes. The partial overlap of the box "complexity management" with the horizontal time arrow of the project-product processes in Figure 3 symbolizes this approach. Such self-adjusting and self-organizational capabilities are self-evident and incorporated into the structure by natural systems (life systems), but not in the project-product processes. In these processes, these capabilities must be specifically (and artificially) incorporated (Malik, 1984, 2004).

A very small part of control is similar to the first cycle, the traditional principles of management. This is symbolized by the huddled small vertical arrows.

Transclassical or dialectic logic (multivalent logic) acts as the decision basis (Günther, 1976–80; Kramer, 2002). Operation is indeterminate and based on the new emerging paradigm of modern sciences (see the first two sections of this article), which considers dynamic, nonlinear, and multicausal structures and processes, as well as principles of self-organization, evolution, and networking.

Complexity theory can be defined broadly as the study of how order, structure, pattern, and novelty arise from extremely complicated, apparently chaotic systems and, conversely, how complex behavior and structures emerge from simple underlying rules (Cooke-Davies et al., 2007). Complexity theory is based on the historically primary developed theories of chaos, evolution, self-organization, cybernetics, and systems by integrating elements of these.

Complexity in the project environment comes not only from individual structural elements and their interactions, but also from the dynamic effects of each of these changing and then interacting as they change, causing further change in other parts of the system (Whitty & Maylor, 2007). Complex projects are characterized by a degree of disorder, instability, emergence, nonlinearity, recursiveness, uncertainty, irregularity, and randomness (ICCPM, 2008).

Broadly defined, we can recognize four types of project complexity, stated in Table 1 (Remington & Pollack, 2007).

Conclusions

Both these cybernetic cycles govern the project-product process directly and immediately. PM-2 is therefore an integrated approach of the two cybernetic cycles, with several processes and techniques. PM-2 represents a *"dual cybernetic cycle"* principle. The main characteristic is the *coexistence* of a management of complexity (evolution, self-organization, edge of chaos) and the traditional management. Finding the *proper balance* between complexity and traditional management will be the future management art.

The Creation of a Systemic Architecture and Process Model of PM-2

The Systemic Architecture and Process Model

The systemic structure and process model for design and guidance of complex projects by PM-2 is described in Figure 4. This model concretizes the PM-2 concept. The architecture of this model is composed of four Worlds (Saynisch, 1997, 2002, 2005a). It is founded on the basic architecture shown in Figure 3. It has been extended by two additional fields:
- the universe of the human behavior (World 3) and
- the universe of ground rules and ways of thinking (World 4).

These four Worlds show superposed reciprocal actions (Saynisch, 1997, 2002, 2004, 2005b, 2005c). These will be represented in Figure 4 by sectoral overlapping of the Worlds. The term *World* for each field and/or cycle was chosen as a result of the highly individual features. Each field exhibits its own bodies and schools of thought, separate logics, and action modes.

What is the context of PM-2, PM-1, and the four Worlds? Misunderstandings about this frequently arise. PM-2 as an

| Type	Comment
Structural complexity	Numerous individual structural elements; often described as "complicated"
Technical complexity	Complexity in project-product, among others, from technical or design problems
Directional complexity	Unshared goals and goal paths, unclear meanings and hidden agendas
Temporal complexity	Results from unanticipated environmental impacts, such as legislative changes or civil unrest

Table 1: Types of project complexity.
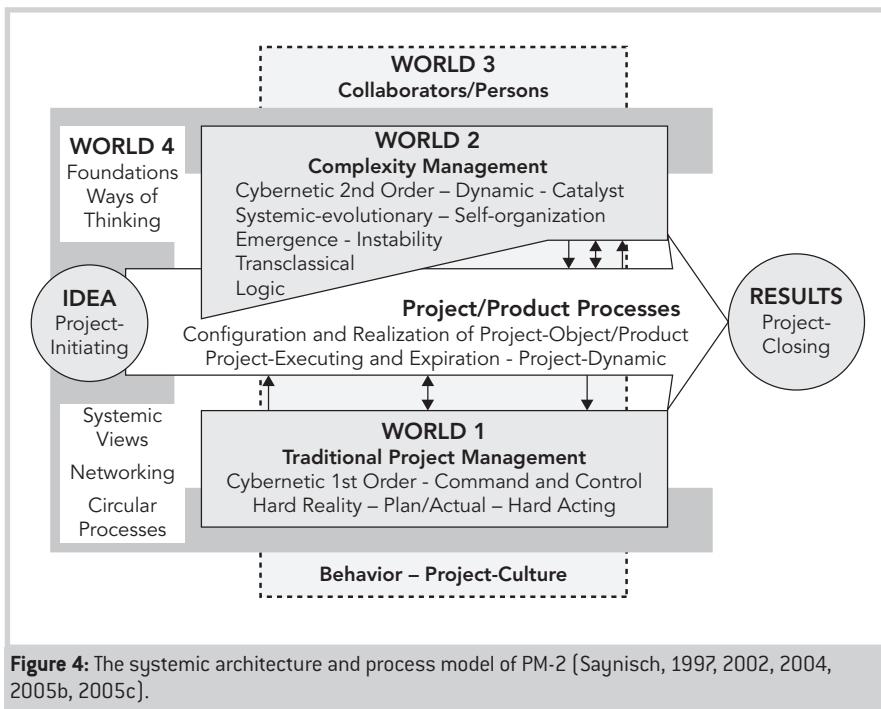
Figure 4: The systemic architecture and process model of PM-2 (Saynisch, 1997, 2002, 2004, 2005b, 2005c).

advanced form of project management incorporates PM-1 and all other elements of the four Worlds, which deal with complexity, for a holistic management system of single projects (from simple projects to complex projects). Therefore, apply the formula:

PM-2 = World 1 + 2 + 3 + 4; or

PM-2 = PM-1 + World 2 + partial World 3 + 4.

PM-1 as traditional project management correlates World 1 and the traditional aspects inherent in Worlds 3 and 4 (techniques and hard facts, based on the Cartesian/Newtonian/Enlightenment paradigm, the "mechanistic" sciences) for a holistic management system of single projects (without complex projects). Therefore, apply the formula:

PM-1 = World 1 + partial Worlds 3 and 4.

The work carried out in Worlds 1 and 2 controls the project-product process directly and immediately. However, the additional Worlds 3 and 4 control the project-product process indirectly, with a more infrastructural and logistical character.

The four Worlds will be explained in detail in the following chapter.

The Four Worlds as Basic Elements of PM-2

World 1 is the universe of a *traditional approach* to project management. The principle of Cybernetics First Order is the logic of control. Acting and techniques are in the center of control. Problem solving comprises primary linear and goal-oriented information processing (e.g., plan/actual comparison and mode of acting). The international standards of project management—*PMBOK® Guide* (PMI, 2008a), ICB-3 of IPMA (2006), and ISO 10006 (International Organization for Standardization [ISO], 1997)—deal extensively with this World (see the "Limits of Traditional Project Management" section).

Nearly 75% of the project management literature has been covering these themes for more than 45 years.

World 2 is the universe of the management of *complexity*. The principle of Cybernetics Second Order is the logic of control. Mastering of high evolutionary dynamics, of complex instabilities,

and of situations with self-organization and/or self-reference is important. Important methods are communication, observation, and perception of project dynamics. Problem solving primarily comprises the consideration of a system approach, thinking in networks, and circular processing. "Control" means more influence and emergence of consciousness instead of precise and quantitative plans or duty points—for example, by interventions, supervisions, or audits.

This World has to this point very rarely been discussed within project management literature.

World 3 is the universe of *human behavior*. Man and his behavior in groups or organizations is in the center of control. Project culture will also be an important part. In World 1 and 2, the object logic dominates the object dimension. In World 3, the logic of behavior (e.g., values, personal attitudes, personal interests) dominates. Important methodical approaches include, among others, motivation, coaching, reflections, support of learning, leading with confidence and goals, and communication of visions. The "behavioral competences" of the IPMA's ICB-3 can be mainly located in this World. Also the competence standard of ICCPM (2008) can partly be classified here (see the "PM-2 vs. Complex Project Managers Competency Standard [CPMCS]" section). World 3 is composed of elements that deal with the traditional approach to project management as well as of elements that deal with the management of complexity.

The project management literature in this World has been growing in the last decade.

Foundations, ways of thinking, systemic views, and networking are important aspects of the universe of *World 4*. Ways of thinking and the principles of acting will influence the other three Worlds. Also, it can be focused only for the control tasks in World 1 or 2. Thinking in cycles, the principle of pilgrim steps

(two forward, one backward), and networked jumps between the steps of problem solving are ways of thinking and acting principles in World 4 for applications in World 2. On the other hand, for example, foundations and principles of measurement are elements for applications in World 1. World 4 is composed of elements that deal with the traditional approach to project management as well as of elements that deal with the management of complexity.

Assurance of *systemic guidance rules* (e.g., principles for scenarios of noncontrollable situations) and additional systemic evolutionary principles are further elements of World 4. The interconnectedness with the project-environment process is also part of this World 4—for example, the networking to company aspects (project portfolio management, or the "project-conscious management"; compare the "PM-2 vs. Project-Oriented Company—Multiproject Firms at the Edge of Chaos [MUPEC]" subsection; Geraldi [2008]). But also the connections to stakeholders and the relations to political framework conditions or legal requirements are part of World 4.

For the principles, methods, and procedures of the single World levels, steps or modules can be created within the respective World, focusing on various characteristics.

Scope and Domain of Model

The generic model of PM-2 represents a *reference model*. It is valid for all types of projects in different fields of business and function. As a well-defined model, it is characterized by a high degree of abstract thinking. For concrete application in projects (i.e., an organization, software, or research and development project) or within a company, it must be adapted accordingly. The result is an independent model based on a new, concrete application level.

The previous explanations for the concept of PM-2 are focused on the presentation and execution of a single project. For the management of a project-oriented

company (program/portfolio management), for example, these explanations do not apply. A company is less defined by obtaining a fixed time schedule than by competitiveness and growth. In this context, complexity management (World 2) plays an important role. For future projects, the PM-2 approach is to be expanded to meet this demand. This situation is discussed by Geraldi (2008) and Rietiker (2006). Further discussions are in the "PM-2 vs. Project-Oriented Company—Multiproject Firms at the Edge of Chaos (MUPEC)" subsection.

Potential Use of PM-2

PM-2 is an ideal draft for *mastering complexity in projects and project management.* Figure 5a shows the two dimensions of complexity (structure adapted by Jaafari, 2003):
1. Environmental (e.g., society and economy) and
2. Project (e.g., new technologies).

Traditional project management (First Order) covers only the field of lower complexity. Project Management Second Order covers all fields of complexity (Saynisch, 2005b, 2005c).
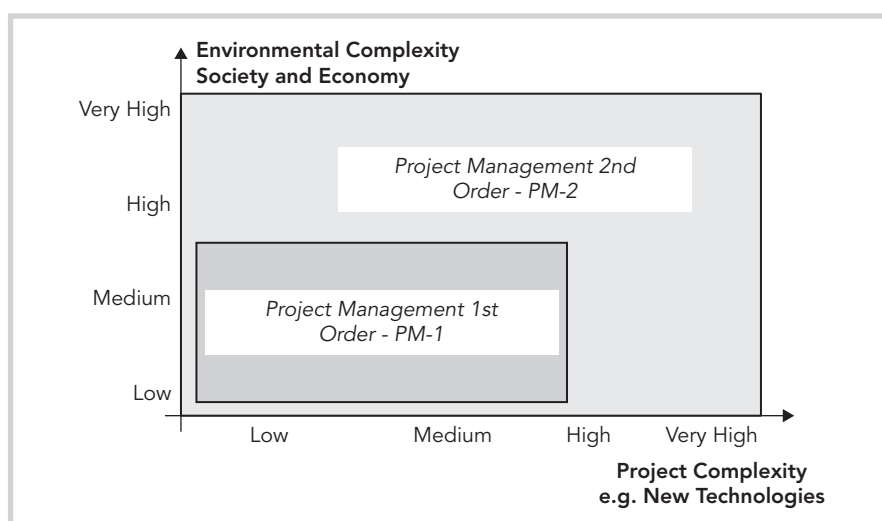

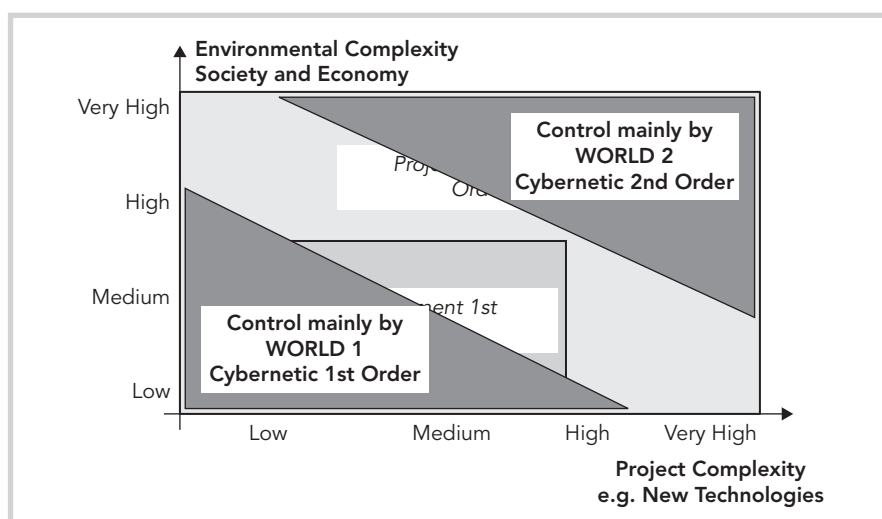**Figure 5a:** Mastering of complexity through PM-2.

Figure 5b: Different tools for mastering of complexity through PM-2.

Depending on the project types and the specific situation of complexity, different tools of World 1 (Cybernetics First Order) and World 2 (Cybernetics Second Order) need to be applied to reach the goals. This is shown in Figure 5b.

Implementation of PM-2 in Different Project Types

Some examples for the types and manifold layers of the reciprocal actions and fluctuations of crucial points that can explain the tailoring of PM-2 for application in different project types follow (Saynisch, 2002, 2003, 2005b, 2005c; also see Figure 6).

Construction projects based on conventional technologies and in the home country can be controlled primarily by World 1. The reason for this is that the object system can be sufficiently determined and the acting system shows a low complexity.

A fundamentally different situation will emerge if the construction project is carried out in another field of culture (e.g., with Islamic culture). The scope of the construction project contains a high degree of self-executions in this field of culture. In this case, World 3 emerges and the control processes of World 1 need to be expanded to World 2. For example, this is the situation when a European contractor performs a project in an Arab country.

If *research and development projects* contain advanced technologies (e.g., biotechnology), an extensive and simultaneous control from World 1 and 2 is needed. If such projects expand to a "megaproject" (e.g., the new European Galileo Project or the historical Apollo Project), it will be necessary to simultaneously control it from all four Worlds.

If *organizational projects* exhibit a high potential for effects of self-reference, the control must be performed mainly by World 2, with the support of World 3. In most cases of organizational projects, IT systems (software and installation of computer hardware) are integrated. If this case occurs, an additional control

Project Types	WORLD 1	WORLD 2	WORLD 3	WORLD 4
Construction Proj. (traditional)	●	·	·	●
Construction Proj. (in other culture)	●	●	●	●
R & D - Projects (advanced techn.)	●	●	●	●
R & D - Projects (Megaprojects)	●	●	●	●
Organizational Proj. (self-reference)	●	●	●	●
Organizational Proj. (with IT systems)	●	●	●	●

Figure 6: Implementation of PM-2 in different project types (great circles represent high influence of World 1, 2, 3, or 4; Saynisch, 2005c, 2008).

with the methods of World 1 would be necessary.

Global projects are mostly global in scope and are executed by team members native to and located in many cultures and countries. To deal with the impact of these cultural issues, World 3 will play an important role. Furthermore, the control processes of World 1 have to be expanded to World 2, and World 4 will play an important role.

Principles, Methods, and Processes in PM-2

Principles, Methods, and Processes in World 1

Concepts of action in World 1 (i.e., traditional project management) do not require further explanation. Good general descriptions can be read in international standard works such as the *PMBOK® Guide* (PMI, 2008a), the ICB3 of IPMA (2007), and the ISO 10006 (ISO, 1997). The *PMBOK® Guide* is limited to World 1, whereas the ICB also refers to the methods in World 3. Both of them include some elements of World 4.

Concepts of Action as Well as Principles and Strategies in World 2
General

The following broadly defined description of concepts explains the meaning

of principles, strategies, and approaches that have an effect on PM-2 in addition to or instead of traditional concepts in World 2. They partly refer to World 3.

In his work on self-organization, Probst (1987) described 45 planning and guiding principles for organizations in self-organizing systems. Probst demonstrates numerous principles and procedures for management on the basis of the theory of self-organization. These are likewise principles for action in World 2.

Malik (1984, 2004) also discusses several approaches for solutions in his work. In their work on evolutionary management, Laszlo and Laszlo (1997) define 18 principles. Laszlo and Laszlo present many principles for an evolutionary management. The authors cluster these into three principles: (1) organizational principles, (2) strategic principles, and (3) operative principles. All of these are principles for handling in World 2.

These principles of Probst, Malik, and Laszlo and Laszlo are established with a focus on general management, not especially for project management. But they can be easily transferred without deficit into the world of project management.

Especially for project management, we have developed numerous principles,

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methods, and techniques in the research program "Beyond Frontiers of Traditional Project Management." These are condensed into 30 theses, which are presented in the documentation book (Saynisch, 2003; Saynisch & Lange, 2002). In the competency standard of ICCPM (2008), numerous procedures are described.

This is to make clear that *numerous concepts of action already exist for World 2*. Due to the space constraints of this article, only some selected elements of acting concepts of the concept description will be explained in the next section.
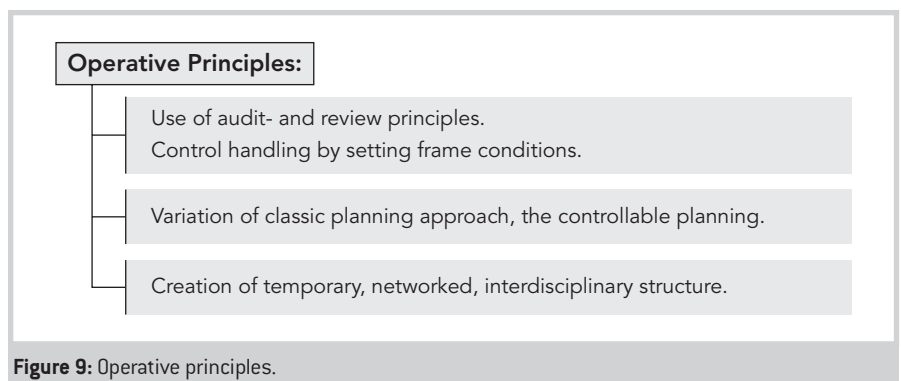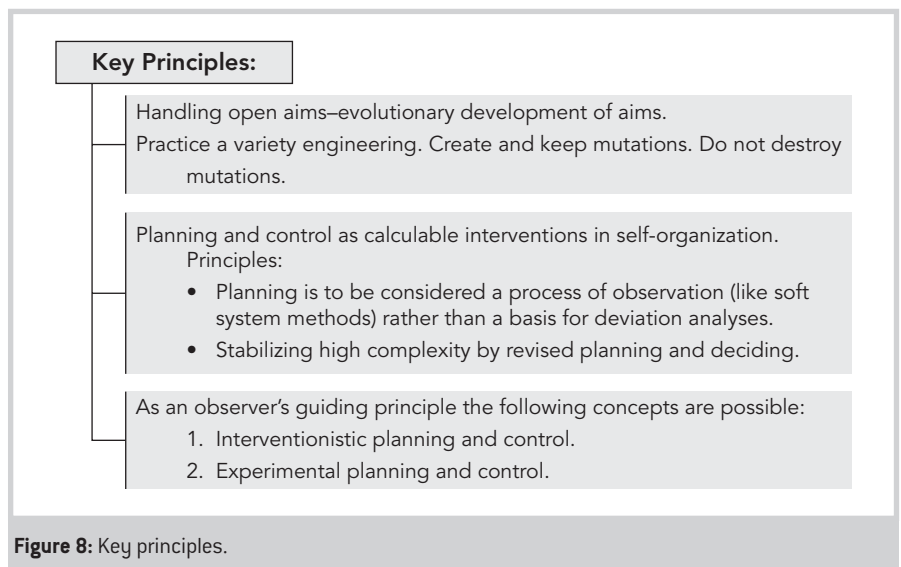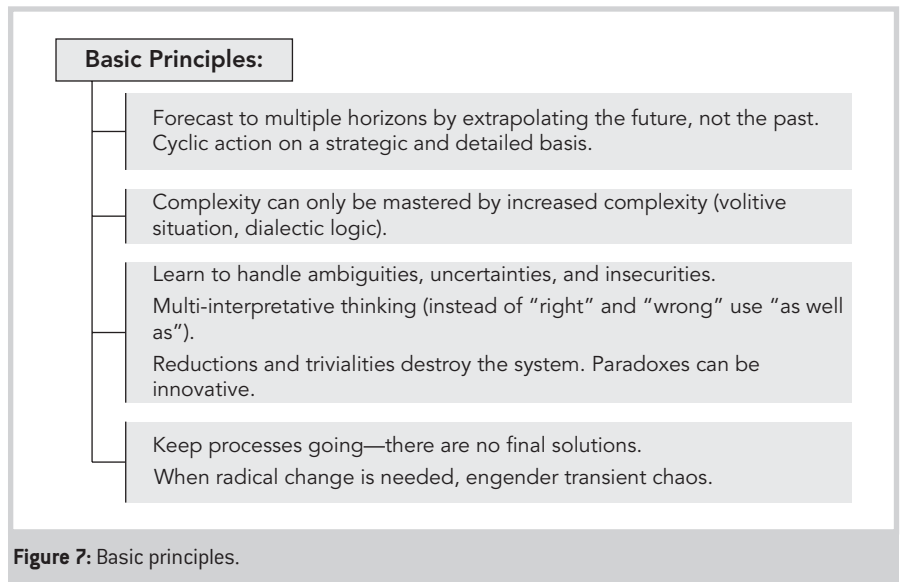
An Overview of Selected Concepts of Action

The following named concepts of actions are based on interpretations by Probst (1987), Laszlo and Laszlo (1997), and the 30 theses in the documentation book (Saynisch, 2003; Saynisch & Lange, 2002). These selected concepts of actions are clustered in basic principles, key principles, and operative principles and shown in Figures 7, 8, and 9.

Detailed Description of Selected Elements of Acting Concepts (Saynisch, 1997, 2002)

Interventionist Planning and Control (Key Principle in Figure 8). As the classic approach, the control organization acts outside of the system, the principle of Cybernetics of First Order. Self-organizing systems can realize new common values due to disturbances (analogies to the attractors of the chaos theory). Management can try by directed disturbances to motivate systems to transform themselves in order to comply with aims. The setting of conditions is the basis for desired aims.

Experimental Planning and Control (Key Principle in Figure 8). Controlling is part of the system: this is a feature of Cybernetics of Second Order or Cybernetic of observing systems. Experimental planning and control is not limited to one solution but attempts several possibilities. For example, keeping variation (mutation) and evaluation (selection) of possibilities are the elements of experimental planning and

Basic Principles:

Forecast to multiple horizons by extrapolating the future, not the past. Cyclic action on a strategic and detailed basis.

Complexity can only be mastered by increased complexity (volitive situation, dialectic logic).

Learn to handle ambiguities, uncertainties, and insecurities.
Multi-interpretative thinking (instead of "right" and "wrong" use "as well as").
Reductions and trivialities destroy the system. Paradoxes can be innovative.

Keep processes going—there are no final solutions.
When radical change is needed, engender transient chaos.

Figure 7: Basic principles.

Key Principles:

Handling open aims–evolutionary development of aims.
Practice a variety engineering. Create and keep mutations. Do not destroy mutations.

Planning and control as calculable interventions in self-organization.
Principles:
- Planning is to be considered a process of observation (like soft system methods) rather than a basis for deviation analyses.
- Stabilizing high complexity by revised planning and deciding.

As an observer's guiding principle the following concepts are possible:
1. Interventionistic planning and control.
2. Experimental planning and control.

Figure 8: Key principles.

Operative Principles:

Use of audit- and review principles.
Control handling by setting frame conditions.

Variation of classic planning approach, the controllable planning.

Creation of temporary, networked, interdisciplinary structure.

Figure 9: Operative principles.

control. Thus, it corresponds to the basic principle of evolutionary planning.

With the concept of experimental planning and control, the effects recursively lead back into the process. Therefore, expectations and effects of planning are related to each other, and planning and control becomes an experiment.

The basic principle is to gain knowledge for checking previously set hypotheses and to reintegrate this knowledge into the planning process. This is also the principle of the leading project in the research program.

Experimental planning and control is a challenging process. The result is successful if the desired state is approximately obtained.

Controllable Planning (Operative Principle in Figure 9). This is a variation of the classic planning approach. Also, within the traditional planning and control process, the feedback principle is used, but only in the case of deviations—and reluctantly in the majority of cases. Mostly, the feedback principle is limited to a part of the problem-solving process. The approach for PM-2 is that as of the project start, planning is to be adjusted to many feedback processes (planning revisions).

This "controllable planning" functions according to the principle: "Better plan roughly and control quickly (frequently) than plan in detail and control slowly (sparingly). Whoever plans too much in detail loses time and chances." The author has had good experiences following this principle in the research and development (R&D) field for 40 years.

Comprehensive, Integrated Principles, Methods, and Processes—A Continuum of Project Management

There are still more extensive planning and guiding approaches that already symbolize a comprehensive system. Many times traditional approaches and advanced principles will integrate to a higher level of approach and processes.

The distinction between World 1 and World 2 is an analytical categorization that is necessary for precise and consistent analysis, scientific discourse, clear descriptions, understandable teaching or learning, and unambiguous communications. But applications or practical works use integrated, holistic, or systemic processes and modes of actions, not analytical categorizations. Such an integrated higher level of approaches and processes points out a characteristic of "continuum." You cannot "teach" a continuum of processes like analytical distinct elements, but you can "train" the application.

With this view of a practical approach, PM-2 represents not only the management of World 2; PM-2 is designed as a management system for the continuum of Worlds 1, 2, 3, and 4. PM-2 therefore also includes the traditional management approach, PM-1 (see the "Principles, Methods, and Processes in World 1" subsection). A management system related to each separate World is singularly not viable in a practical approach for mastering complex projects.

Extensive planning and guiding approaches already exist that symbolize a system, a continuum. Some examples of relevant items for general management in this context are:
- universal methodology of problem solving (St. Gallen) (Ulrich & Probst, 1988) and
- Soft Systems Methodology (SSM) of Checkland (1981; Checkland & Scholes, 1999).

Relevant items especially for project management in this context are, for example, a set of actions in the competency standard of ICCPM (2008). For example: "Wave planning—in complex projects the planning process is usually recursive and nonlinear, rather than linear. Wave planning plots nodal points for gathering information, design, and implementation, allowing nonlinear and recursive patterns to be portrayed in a linear model" (ICCPM, 2008). Also some principles, methods, and processes, described in the "An Overview of Selected Concepts of Action" and "Detailed Description of Selected Elements of Acting Concepts (Saynisch, 1997, 2002)" subsections represent a continuum—for example, the "controllable planning." In the book *Tools for Complex Projects*, Remington and Pollack (2007) describe a set of tools and techniques that mostly integrate traditional and advanced approaches—for example, the "multimethodology in series or in parallel."

A *cyclic acting principle* (iterations, circular processes, feedback) seems to prevail as a common and central principle among many methodical approaches in the research program (Saynisch & Lange, 2002), as also selectively described earlier. Part of this principle is the *evolutionary paradigm* of the process "variation–selection–keeping." The cyclic acting principle is similar to the method of "wave planning," with its recursive character. Wave planning is regarded as a diversification element of a more application-level of the generic principle of cyclic acting.

Furthermore, in this context, "Ashby's Law" is a central principle. It is the law of the necessary variety for controlling complex systems: "Only Variety Can Absorb Variety" (Ashby, 1970). To control a system absolutely, a range of variety (or complexity) of the control element that displays the same range of variety of the controlled system at minimum is necessary. In the same way that we cannot translate Shakespeare with a vocabulary of 3,000 words (Malik, 1984, 2004), if the control element exhibits less variety, then a deficit of variety exists and the system is out of control.

The Phenomenon of Evolutionary Overlapping of Traditional Methods

Human beings have become what they are by evolutionary processes—thus, they think and act according to evolutionary principles. This is roughly one of the most important postulates of the evolutionary epistemology theory (EE) (Riedl, 1985; Riedl & Wuketis, 1987).

As infants, human beings still act according to evolutionary principles.

At the latest, in kindergarten, school, or professional training, this natural behavior is suppressed by submission to the rules of the monocausal world, the world of fixed realities (normal socialization)—that is, World 1. Natural gifts cannot be completely overlapped. Thus, within the action of management, evolutionary overlappings emerge among classic principles (e.g., if traditional management principles do not offer sufficient assistance). Mostly, they are not recognized as such (since this happens unconsciously) but are regarded as new (sometimes flexible) varieties of traditional principles.

Malik (1984, 2004, p. 120f) correctly characterized this paradoxical situation of how an evolutionary approach is defined as the success of a traditional approach: "These apparent paradoxes are in reality the result of self-deception like an optical illusion. We are subject to the illusion to be confronted with (traditional) management where in reality the result was accomplished on an evolutionary basis."

Therefore, the use of evolutionary, systemic operating modes is already much further practiced than some traditional management theorists are ready to admit.

Demonstration and Verification—PM-2 in "Real Life" Today

Finally, concrete situations demonstrate that some elements of PM-2 (particularly World 2) have already been transformed into practical use and are presently regarded as "state of the art." These concrete situations represent simultaneously a continuum of principles and methods, as described in the "Comprehensive, Integrated Principles, Methods, and Processes—A Continuum of Project Management" subsection.

The New "Evolutionary Acquisition Model" of DOD

Maybe everyone knows that project management was developed by the Department of Defense (DOD) in conjunction with NASA in the early 1960s. AFSCM 375 was one of the first
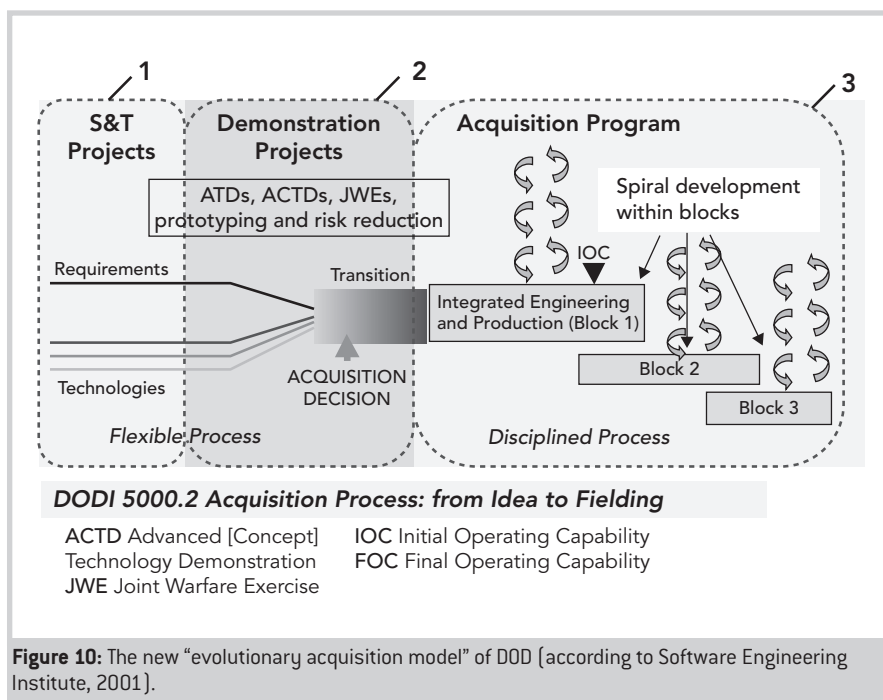

Figure 10: The new "evolutionary acquisition model" of DOD (according to Software Engineering Institute, 2001).

documents to be published on project management. Today, DOD again takes on a leading role by incorporating new ideas for a future project management. DOD developed a new acquisition model, called *evolutionary acquisition* (EA) that reduces cost and cycle times (Software Engineering Institute, 2001).

EA will be used for large, complex, and software-intensive projects. Evolutionary acquisition means an acquisition strategy to adapt to a changing environment by rapidly acquiring and sustaining a supportable core capability and incrementally inserting new technology or additional capability.

In an evolutionary approach, as shown in Figure 10, the delivery to the user is divided into two or more blocks, with increasing increments of capability. Block 1 provides the initial deployment capability. The technology is developed somewhere and adopted on trial. If successful, it becomes the subject of advanced technology demonstration (ATD). In the acquisition program phase, the evolutionary acquisition will begin. The key of the concept is

that the acquisition occurs in a sequence of blocks, with each block culminating in fielding some fraction of the whole program's capability. In each block of cycling processes, an evolutionary approach will be performed (also called "spiral development" by Boehm). Important features of the concept are:

• Evolutionary acquisition implies evolutionary requirements.
• Evolutionary acquisition also implies evolutionary fielding with impacts on training and sustainment.

This evolutionary acquisition strategy is primarily an application of the "Evolution First Order," the concept of Darwin. The term *Evolution First Order* was explained in detail in a previously published article in this journal (Saynisch, 2010).

Evolutionary Processes in the Agile Software Development—Agile Project Management

In the past, progress in software engineering consisted of the introduction of ever more precise operating models.

But for reaction of rapid innovation cycles, to ensure survival on the market, they became far less suitable. A change of some former values became necessary, for which the term "agile development" was chosen.

At the beginning of a project, aims, as before, are determined and set by means of a development strategy with which they are to be achieved. The development strategy has to give an answer to the question of how many releases are necessary for a product and which value each release offers to the customers. The process of planning not only takes place once at the start of the project, but cyclically, always before the start of the release development. Each release is given to the customer in real operation, and the experiences there go directly back into the development of the next release.

This agile operating mode is very similar to the previously described "evolutionary acquisition model" of DOD. Ultimately, it is also an application of the cyclic evolution process "variation–selection–keeping." Therefore, the agile project management corresponds to the principles of PM-2, a precise cooperation of World 1 and World 2. But the phenomenon of the evolutionary overlapping of traditional methods (see the "Comprehensive, Integrated Principles, Methods, and Processes—A Continuum of Project Management" subsection) emerges at this point, because the evolutionary elements are realized unconsciously (Saynisch, 2006).

PM-2 Versus Complex Project Managers Competency Standard (CPMCS)

The International Centre for Complex Project Management (ICCPM) establishes the CPMCS (ICCPM, 2008). This standard defines complex project management as an emerging natural extension of traditional project management to create a specialist profession. The standard moves away from existing approaches and identifies new project management competencies. Project

managers need to accept that the implementation of complex projects is a dynamic system and, to a large degree, unknowable. Detailed long-term planning is, therefore, impossible. Indeed, applying traditional project management approaches, with their focus on long-term planning, rigid structures, precise work-breakdown structure definition, and elaborate control rules, is counterproductive—it will drive the complex project toward failure (Saynisch, 2007).

The CPMCS moves away from traditional philosophies, approaches, and languages, which cannot adequately describe complex projects. Instead, this standard uses a systems thinking philosophical approach and methodology, based upon the premise that "you cannot understand a whole through analyzing its parts." Therefore, "Views" provides insights from multiple perspectives that together provide holistic understanding; and a holistic understanding of the competencies required for the project management of complexity can only be achieved through using multiple views. The standard establishes nine new competency areas, titled "Views" (e.g., "View 4: Innovation, Creativity, and Working Smarter" and "View 6: Systems Thinking and Integration").

The CPMCS make a clear distinction between traditional project management (existing and expanded traditional competencies) and complex project management (new complex project management competencies). Therefore, the CPMCS principles are similar to the concept of PM-2, described in the "Research Results for the Basic Concepts of PM-2" and "The Creation of a Systemic Architecture and Process Model of PM-2" sections.

Both the CPMCS and PM-2 deal with a paradigm shift in project management. Both are concerned with the inability of traditional project management to successfully deliver complex projects and programs. Both radically redefine project management with

many additional principles, methods, and processes. Both deal with complex systems, which are defined as unpredictable, nonlinear, unstable, disordered, emergent, and so on.

But there are also *differences*. The ICCPM standard is focused on large projects: international aid, defense, climate change, disaster relief, mergers, policy implementation, pandemics, national development, and change in large organizations, as well as construction of major plants. As a reference model, PM-2 is valid for all types of projects in different fields of business. PM-2 is characterized by a high degree of abstract thinking.

Furthermore, the ICCPM standard mainly deals with competences—PM-2 is focused on the following trinity: processes, structures, and management systems. In addition, the ICCPM standard was established in 2005 in Australia and has had budget resources; PM-2 was launched ten years earlier in Germany with no financial support, with the only resources being the great engagement of personal involvement of team members. Finally, one important difference is the orientation of contents:

- a scientific basis on the PM-2 side (PM-2 assures more detailed and transparent deduction of the underlying research in modern sciences) and
- application and implementation details on the ICCPM standard side.

Therefore, both concepts complement each other. There is synergy in the potential of both concepts and integration activities.

PM-2 Versus Project-Oriented Company—Multiproject Firms at the Edge of Chaos (MUPEC)

The previous explanations for the concept of PM-2 are focused on the presentation and execution of a single project (see the "Scope and Domain of Model" section). The general identification model of PM-2 is a horizontal time

arrow, representing the project-process with the two cybernetic cycles of complexity and traditional management, which navigate and control this project-process. This is demonstrated in Figure 3. For the management of a project-oriented company, for example, these explanations do not apply. A company is less defined by obtaining a fixed time schedule than by competitiveness and growth. This situation is discussed by Rietiker (2006).

But complexity management also plays an important rule at project-oriented companies with their program/portfolio management. For these challenges, Geraldi (2008) has established a remarkable conceptual model. This specifically defines the edge of chaos (coexistence of order and chaos) for multiproject firms based on the match between the complexity of the project portfolio and flexibility of its organizational units. The general identification model of this basic approach for project-oriented companies is a map to assess this match and mismatch of complexity and flexibility. This map proposes four regions or organizational archetypes: the creative-reflective, the mechanic structured, chaotification of order, and bureaucratization of chaos.

Both conceptual models, the PM-2 and the multiproject firms at the edge of chaos (MUPEC), include some similarities. For mastering complex situations in the world of projects, both deal with a *coexistence and balance* between order and chaos, between traditional and complexity management, as an essential characteristic for the challenges.

For a future comprehensive "rethinking of project management" and for an emergence of a radical new view of a systemic project management world, an integration approach of both models and perspectives (single project and company) will be necessary. But this is a challenge for future research. The significance of both models and perspectives has been highlighted by awarding of the IPMA Research Award in 2007 and 2008 (IPMA, 2007, 2008).

The Future—Integration Aspects of PM-2, CPMCS, MUPEC, ICB3, and PMI Standards

The previous project management knowledge field, represented by standards of the IPMA and PMI and based on traditional management understanding (see the "Limits of Traditional Management" section), will not resolve the profound challenges. It furthermore remains an important position (the "Need for Two Cybernetic Cycles of Control" subsection). But this previous knowledge field must integrate with the advanced models, which deal with complexity, such as PM-2, MUPEC, or the CPMCS (see the "Research Results for the Basic Concept of PM-2," "The Creation of a Systemic Architecture and Process Model of PM-2," "Potential Use of PM-2," "Implementation of PM-2 in Different Project Types," and "Principles, Methods, and Processes in PM-2" sections and the "PM-2 vs. Complex Project Managers Competency Standard [CPCMS]" and "PM-2 vs. Project-Oriented Company—Multiproject Firms at the Edge of Chaos [MUPEC]" subsections). This section deals with the integrated view of the context and relations of PM-2, MUPEC, the

CPMCS, IPMA ICB3, and PMI standards (Saynisch, 2008a, 2008b).

Integration of Previous Project Management Knowledge Field With CPMCS and MUPEC

In Figure 11 you will note in three vertical columns the ICB3 of IPMA with its technical, behavioral, and contextual competences, as well as the four levels of competences in the ordinate. The three vertical columns of the *PMBOK® Guide* (PMI, 2008a), *Organizational Project Management Maturity Model* (*OPM3®*) (PMI, 2008b), and the *Standard for Program Management* (PMI, 2008c) and the *Standard for Portfolio Management* (PMI, 2008d) flank the ICB3. The three vertical columns of the PMI's Program/Portfolio Management, *OPM3®*, and contextual competences of ICB3 represent the integrated view of multiple projects, while the other three vertical columns represent a single project.

On the top of the three vertical columns of a single project in the area of traditional management is the field of CPMCS with nine views for the management of complexity. The CPMCS has
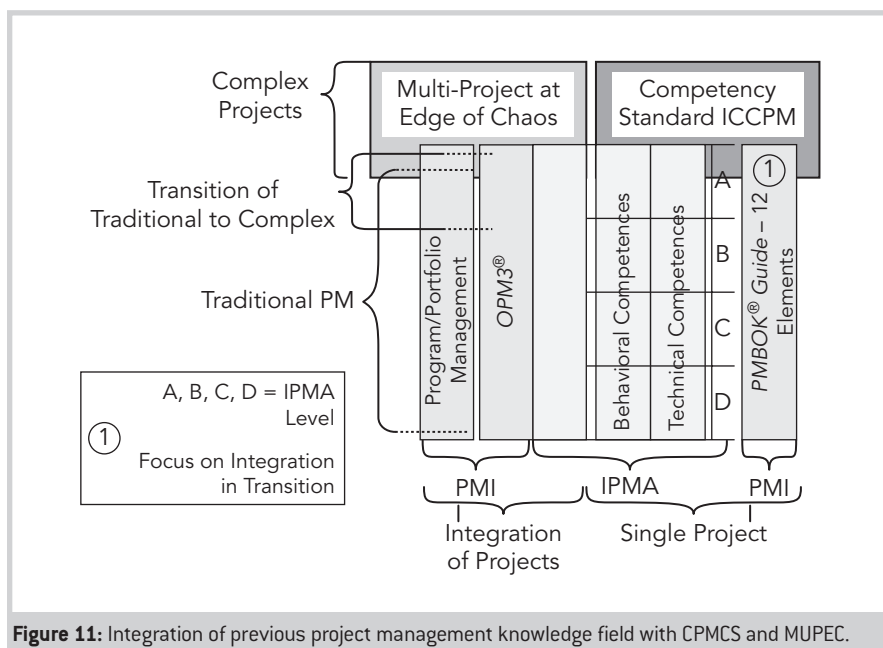

Figure 11: Integration of previous project management knowledge field with CPMCS and MUPEC.
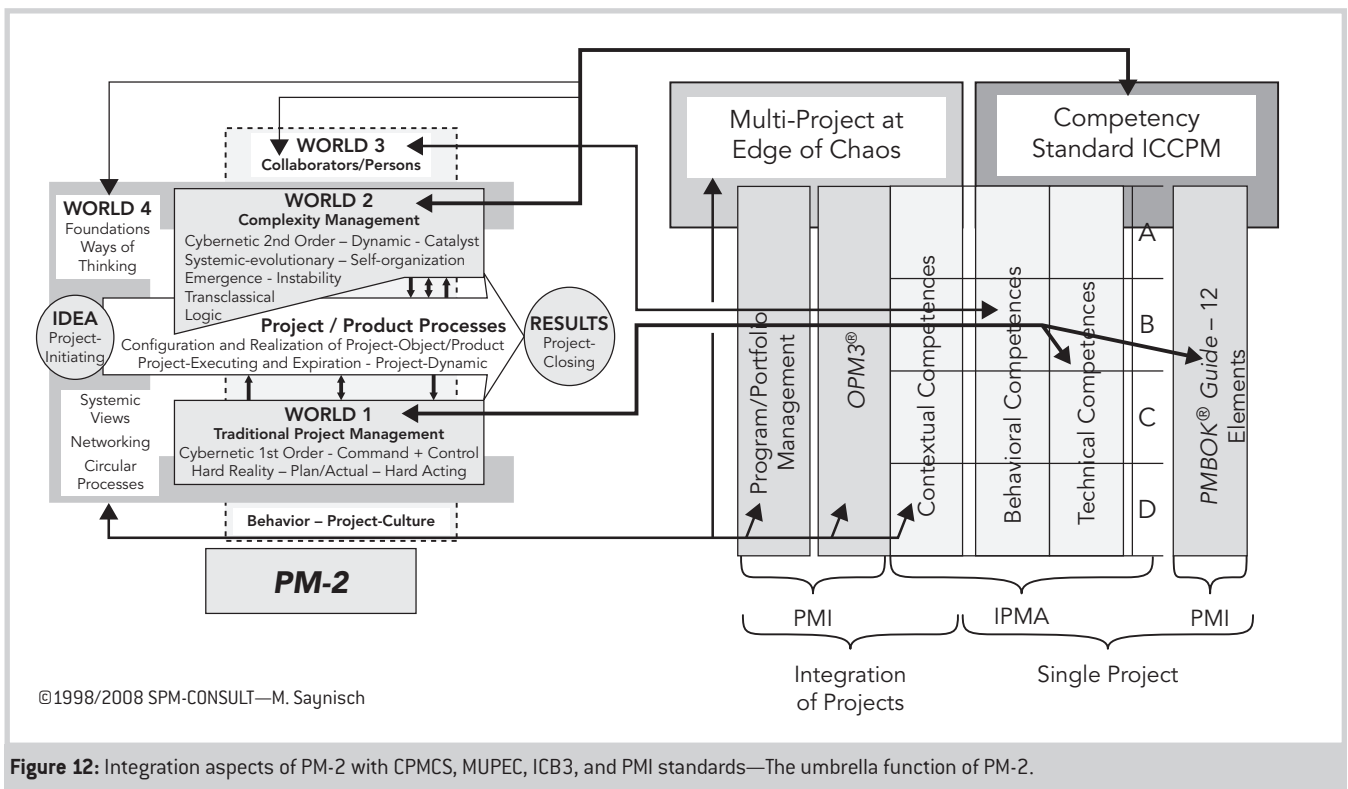
Figure 12: Integration aspects of PM-2 with CPMCS, MUPEC, ICB3, and PMI standards—The umbrella function of PM-2.

no focus on integration of projects; it concentrates on a single project. You will note that this field represents a higher level of competency as the A-level of ICB3, maybe level A++. Furthermore, it will be clear that the CPMCS complements the traditional management by the management of complexity. You can see that the complexity and the scope of competences increases from bottom to top. Analogous to the CPMCS at a single project, the MUPEC represents a higher level of competency for complexity situations at integration of projects.

Additional Integration With PM-2—The Umbrella Function of PM-2
The PM-2 with its four Worlds is pictured at left in Figure 12. The relations of PM-2 to the CPMCS, IPMA ICB3, and PMI standards are represented by arrows; the broadness of the arrow represents the intensity. With World 2, the complexity management corresponds primarily and intensively with the CPMCS of ICCPM. Also, Worlds 3

and 4 show relations to the CPMCS. World 3 corresponds primarily with the behavioral competences of ICB3. World 1, the traditional project management with direct control of project processes, corresponds primarily and intensively with the *PMBOK® Guide* and the technical competences of ICB3. Furthermore, World 4 is related with PMI's *Standard for Program Management* (PMI, 2008c) and *Standard for Portfolio Management* (PMI, 2008d), *OPM3®* (PMI, 2008b), the contextual competences of ICB3 (IPMA, 2006), and the MUPEC.

PM-2, with its feature of reference models, acts as an umbrella for the elements of the CPMCS, ICB3, and PMI standards. PM-2 will assure a framework for integrative reorientation of these concepts and standards.

Conclusions and Perspectives
The descriptions of PM-2 in the preceding sections give an answer to the challenge for an advanced understanding of project management for mastering

complex projects and will therefore be the concept in project management for the coming decades.

The conclusions as well as the challenges for the future are that PM-2, with its feature of reference models, will help to develop and integrate the widespread competencies for the management of complex projects in the traditional and advanced field. These development and integration operations should be implemented:
• in a systematically and transparent manner;
• based on a transparent deduction from modern natural and social scientific theories with their paradigms;
• with transparent differentiation into traditional and new complex project management aspects as well as systemic views;
• with tailoring aspects to segmentation into types or categories of projects; and
• with a systemic and separation view to personal competences and organizational processes.

PM-2 assures the overcoming of the "Paradox of Project Control" stated by Svetlana Cicmil (Cicmil et al., 2009).

The research and development of PM-2 and its environment is still in a draft state. We need an *international research initiative* for extended research and development on these subjects to come to better practical solutions. Furthermore, we need intensive and new education and training programs all over the world that reflect the ideas and thought patterns of PM-2.

We also need further research for:
- an integration approach of the PM-2 concept with the conceptual model of MUPEC, the integration of single-project aspects with the viewpoints of program/portfolio, as described in the "PM-2 vs. Project-Oriented Company— Multiproject Firms at the Edge of Chaos (MUPEC)" subsection.
- a comprehensive and integrated system of the principles, methods, and procedures in World 2's respective management of complexity, which are very roughly sketched and mostly only listed in the "The Four Worlds as Basic Elements of PM-2" subsection and the "Principles, Methods, and Processes in PM-2" section. This system or methodology should consist of logical and transparent structures (e.g., clusters, breakdowns, and networks) and detailed descriptions, including their relationships and interfaces, which provide holistic understanding (systems thinking) and promote practical implementations.
- suitable adaptation at conditions of the PM-2 reference model by concrete applications.

This article should be understood as a call to begin the discourse, to fulfill the requirements of Bredillet (2007, 2008) for a new perspective and approach in project management research.

Acknowledgment

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