

Assessing and Moving on From the Dominant Project Management Discourse in the Light of Project Overruns

Terry Williams

Abstract—There has been much prescriptive work in project management, exemplified in various “Bodies of Knowledge.” However, experience shows some projects overspending considerably. Recently, systemic modeling research into the behavior of large projects explains project overspend by “systemic” effects and the (sometimes counterintuitive) effect of management actions. However, while this work is becoming more widely known, embedding the lessons in project-management practice is not straightforward. The current prescriptive dominant discourse of project management contains implicit underlying assumptions with which the systemic modeling work clashes, indeed showing how conventional methods can exacerbate rather than alleviate project problems.

Exploration of this modeling suggests that for projects that are complex, uncertain, and time-limited, conventional methods might be inappropriate, and aspects of newer methodologies in which the project “emerges” rather than being fully preplanned might be more appropriate. Some of the current literature on project-classification schemes also suggests similar parameters, without the rationale that the systemic modeling provides, thus providing useful backup to this analysis.

The eventual aim of this line of work is to enable project managers to choose effective ways to manage projects based on understanding and model-based theory.

Index Terms—Project failures, project management theory, systemic modeling.

I. INTRODUCTION

BUSINESS is becoming increasingly projectized, and global spending on projects is now many billions of dollars annually. We have in recent years developed an extensive empirically-based discipline in project management. But common experience is that many projects fail. Why is this? What makes projects behave in a different way from our expectations? What is wrong with our project management theory? And how should managers manage projects differently? This paper uses experience of *postmortem* analysis of a range of failed projects to explain *why* the common project-management discourse can give rise to failed projects, and distinguishes those projects for which new discourses are necessary.

This paper is structured as follows. The current practice in Project Management is introduced and its success (or otherwise)

discussed. Then, a stream of empirical work based on systemic modeling of projects is introduced which has provided explanations for the unexpected size of project overruns. Bringing those lessons to current practice, however, reveals a dissonance with the underlying assumptions of the current project-management discourse. Section IV describes these assumptions and the following section demonstrates this dissonance; this analysis develops project parameters which indicate projects which are likely to have a propensity for these systemic effects. Recognizing such problems, alternative project-management methodologies have been developed and the next section briefly describes some of these. We, thus, have a project-classification scheme based on model-based theory; looking briefly at the currently literature on project-classification in Section VIII shows that this literature backs-up our conclusions. Section IX discusses these results and concludes with initial recommendations both for current practice and a research agenda to parameterize these recommendations.

II. PROJECT MANAGEMENT IN PRACTICE

“Project Management” became well-defined and developed in the 1950s, particularly, in the Atlas and Polaris programs. As methods were formulated and codified, there arose a Project Management “profession,” represented by the Project Management Institute, or PMI, with over 130 000 members (publisher of *Project Management Journal*), as well as some much smaller national organizations under the umbrella of the International Project Management Association (IPMA) (whose official journal is the *International Journal of Project Management*). Over 60 000 PMI members hold a PMI professional accreditation, the “Project Management Professional” or PMP; IPMA member societies have similar schemes.

We take a “project” here to be “a temporary endeavour undertaken to create a unique product or service” [1], or “a unique venture with a beginning and an end, conducted by people to meet established goals with parameters of cost, schedule and quality” [2]. Most definitions refer to this combination of uniqueness, defined objectives, limited time-cycle, and three-fold constraints (cost, time, and quality). Managing projects is quite different from managing operations because ([3]) projects are one off; are time-limited; bring about revolutionary (not evolutionary) improvements; create disequilibrium; use transient teams; start with little precedent; are goal-oriented; and are risky.

Manuscript received December 1, 2004; revised March 1, 2005 and April 1, 2005. Review of this manuscript was arranged by Department Editor J. K. Pinto. The author is with the School of Management, Southampton University, Southampton, SO17 1BJ, U.K. (e-mail: t.williams@soton.ac.uk).

Digital Object Identifier 10.1109/TEM.2005.856572

Both PMI and IPMA have defined “Bodies of Knowledge” or BoKs, what they consider to be the core knowledge of managing projects. In PMI’s case this is the *Project Management Body of Knowledge* or PMBOK [1], an ANSI standard and the basis of the PMP qualification. The U.K. Association for Project Management has also developed a BoK [4], now expanded in the “Project Management Pathways” [5]; other national associations generally use one of these as the basis for their own BoKs [6]. The PMBOK uses five “process groups” representing the life cycle of a project, dividing the knowledge needed to carry out the work into nine “knowledge areas”; the “Pathways” document [7] gives seven sets of processes, less closely aligned with the project life cycle.

The roots of this “core knowledge,” as described in the BoKs, lie within Systems Analysis/Systems Management, most famously the work of Cleland [8], [9]. Morris relates in detail the various projects within which Project Management was developed, concluding that it is a “Systems Management practice” which “in many respects is still stuck in a 1960s time warp” [10]. This present paper looks at the dominant discourse in the community of those who manage projects, in particular as exemplified in the BoKs, which give the Project Management professional bodies’ view of how projects should be managed.

Despite the considerable rise in project management, it had received little attention from the wider management academic community until recent years [11] (other than perhaps within new product development). The project management community has, therefore, developed its discourse and its corporate views without the benefit of substantial dialogue with the wider management community. It is generally accepted that the resulting dominant discourse is based on a very narrow implicit theory, and generally, there has been until recently little consideration of the theoretical implications of its normative techniques and procedures. However, over the past five years, there has been an increasing interest in the management literature, and that is now starting to feed back into the project management community. In particular, Scandinavian writers (e.g., Lundin *et al.* [12], [13], and Sahlin-Andersson and Soderholm [14], dedicated to Lundin) have developed the theoretical base of project management, and papers discussed next by Hodgson [11], [15], Winch [16], and de Meyer/Loch/Pich [17], [18] have appeared in top-ranked management journals.

There isn’t scope to explore fully in this paper where project-based management fits (or does not) within the wider management literature. It does not appear that project management implies any of Deshpande and Webster’s [19] paradigms of organizational culture. In Harrison’s framework [20], [21], the “task” culture is oriented toward getting a project completed; conventional procedures seem to echo this type of language and Andersen’s recent survey [22] found most project-management students reporting the task-culture as dominant in their projects (although not necessarily their organization)—but the task-culture has other implications, and project management methods will fit uneasily in environments where a “person” culture is more appropriate. The seminal work characterizing national rather than organizational culture is clearly Hofstede [23]; while no definitive work has been done linking project success with his dimensions, it is known

that project outcomes are influenced by the power of the project manager (power-distance), and by individuality/collaboration; further, a project culture would naturally be less aligned to uncertainty-avoiding cultures which seek long-standing rules and roles; and some work has tried to classify different project-management styles using Hofstede dimensions, notably Winch’s study of the Channel Tunnel [16], [24], as well as, e.g., Muriithi and Crawford [25] and work (mentioned later) looking at the effect of masculinity/femininity.

Project management as set out by the societies is presented as a set of normative procedures which appear to be self-evidently correct: following these procedures, it is implied, will produce effectively managed projects; and project failure is indicative of inadequate attention to the proper project management procedures. Indeed, the PMBOK document states that the “knowledge and practices described are applicable to most projects most of the time, and that there is widespread consensus about their value and usefulness” [1]. However, it is commonly observed that many projects fail in various ways [26]. The most well-known text outlining such failure up to the mid 1980s is Morris and Hough [27], listing 33 references to data bases of project out-turns, prefaced thus: “Curiously, despite the enormous attention project management and analysis have received over the years, the track record of projects is fundamentally poor, particularly, for the larger and more difficult ones. Overruns are common. . . . Projects are often completed late or over budget, do not perform in the way expected, involve severe strain on participating institutions, or are canceled prior to their completion.” Summarizing their results, they state that “There are hardly any reports showing underruns . . . [cost] overruns are the norm, being typically between 40% and 200%.” Study after study has shown similar results: in the 1980s, the National Audit Office [28] found real increases of 90%, and a survey of 246 U.S. Army programs by Arbogast and Womer [29] showed cost overruns up to 400%; studies in the 1990s generally found similar results, although with less-easily quoted statistics [30]—most collections have been to study particular aspects of overruns (e.g., [31]) or particular industries, such as Flyvberg *et al.* [32] on major transportation infrastructure projects with 90% projects overspent.

Project management procedures have been espoused and are being followed, but appear not to be delivering the benefits they promise. Indeed, Koskela and Howell [33] claim “In the present big, complex, and speedy projects, traditional project management is simply counterproductive; it creates self-inflicted problems that seriously undermine performance.” To consider why project management is not performing as it claims it should, we need to look both at its underlying assumptions and theories, and also at what actually happens in practice and why [34]. A stream of work modeling project behavior has given rise to some explanations for project overruns. Bringing the results of the modeling work into the theoretical debate can explain why project failure happens and can, thus, contribute toward developing a theory of project behavior, particularly, as there have been few empirical positivist studies of projects and their management to develop this theory. This will be used to identify projects with a propensity for such failure and propose dimensions to give guidance on the appropriate management method.

III. SYSTEMIC PROJECT MODELS—EXTENDING OUR UNDERSTANDING

Our understanding of how complex projects behave has been extended over the past two decades by a body of work in systemic modeling, which has supplied explanations of project overruns. A complex system, says Simon [35], is one in which the behavior of the whole is difficult to deduce from understanding the individual parts—that is, when we look at a complex project, while we might know the effects that impacted upon the project and the project out-turns, it can be difficult to understand intuitively how the latter came from the former. It is in such projects, we will see later, that traditional conventional methods can become unstuck. This section of the paper will look at this work and the explanations it offers for project failure; these will then be compared with the underlying project management assumptions and emphases described above to see where these break down and, thus, alternate or adjusted management approaches are needed.

The systemic modeling work is particularly due to two teams. The work discussed in this paper was carried out by a team at Strathclyde University, U.K., including the author; the other team, the first chronologically, was Cooper [36] and others at PA Consulting and also MIT (see, e.g., [37]), who derive similar results. Both teams were both involved in postmortem analysis of a range of projects. The techniques used on the first Strathclyde claim, related to the Channel Tunnel (the “Shuttle Wagons”), are described in Ackermann *et al.* [38], and successive claims have been characterized by the use of these techniques. While this was not a particularly large project, “the value of the final claim was above 2 billion French francs, of which about 45% was accounted for by the outcome of the disruption-and-delay model” [38]. Eden and Ackermann had already developed cognitive/causal mapping techniques, appropriate for studying structures of causality. When applied to projects *post-mortem*, they revealed significant structures of positive feedback loops. This technique not only provides a structuring mechanism for apparently “messy” problems, it also provides a logical structural interface with the systems dynamics technique for producing quantitative results [39]. The work we have carried out at Strathclyde University does differ from the PA work, first, in its underlying stance of beginning from a “clean sheet” and building models based both on documentary and quantitative data and on the project-team’s socially constructed view of the reality of the project, and second, in the clear progression from cognitive maps, to cause maps, to influence diagrams to System Dynamics models. However, the generic results from the two teams are similar. And over these two decades, a fair amount of literature has built up modeling the systemic effects in projects using Systems Dynamics (see Rodrigues and Bowers [40] for literature up to the mid 1990s).

The main results from this work provide explanations for project behavior deriving from systemic interrelated sets of causal factors rather than tracing effects to single causes, hence, “the difficulty in determining the true causes of project performance” [41]. This body of work shows how the systemicity involved produces a totality of effect beyond the sum of the results that would be expected from individual causes.

In particular, key results derive from dynamics set up by these effects turning into positive feedback loops, or “vicious circles,” producing “runaway” projects with huge (or “catastrophic”) overruns. Cooper *et al.* [41] discuss feedback structures as the root of the complexity, pointing to three particular structures that they say generally underlie project dynamics: the main one being the rework cycle (including discovery of unexpected rework) (see also, [42]), the other two being feedback effects on productivity and work quality, and knock-on effects from upstream phases to downstream phases [43], [44]. Our work at Strathclyde looks for positive feedback generally in projects, but it is still this positive feedback which causes the unexpected overruns. Eden *et al.* [45], for example, describe in more detail four typical projects post hoc (and one mid-project); two of the projects overspent by “over 40%” (aerospace) and one “58% above estimate” (construction); the other two (rolling-stock) were actually around 100% overspent; they describe reasons for these overspends, but the quantification, using Systems Dynamics methods [46] is based upon the positive feedback modeling.

Having identified the systemic interaction between effects and the positive feedback set up as a key explanation for project behavior, the Strathclyde work found that many of the key loops identified in this work are set up and exacerbated through management response to project perturbations—hence, the sometimes counterintuitive effect of such actions, often highly magnifying small effects ([46], [47]). This is particularly the case in time-constrained projects, where there is a perturbation to the project as planned, a project manager will have to respond by taking decisions to try to retain planned delivery and planned quality—i.e., (she)he will have to *accelerate* the project; Eden *et al.* [47] shows that the consequence of such actions will be to increase the power of the vicious cycles, since these actions are also disruptions that, in turn, must be contained within a shorter time scale. By taking actions that are implied or suggested by conventional methods (i.e., according to the BoKs) in order to try to deal with late-running projects, managers themselves are exacerbating the feedback and making the overruns worse (Eden *et al.* [47] also shows that to some extent these consequences of perturbations can be traded: extending delivery may reduce some of the consequences of the perturbations, versus reducing delivery delay by accelerating with more disruption costs of extra labour costs). The BoKs do recognize the importance of this aspect of projects, but rather than recognizing the potential for feedback, the Pathways document, for example, in talking about the “time-constrained project” says that “time is a constraint in all projects. The project management approach, therefore, has been developed over time to cope specifically with the time constraint element of projects, and it is clear that the project management process or framework should be used in all circumstances. Thus, in terms of fast projects, the question is not one of how much of the process or discipline of project management can be discarded or ignored but rather what emphasis is placed on the elements of the process...” [48].

There is one other important aspect of these *postmortem* project analyses. The work has identified the existence of positive feedback loops within a systemic structure of causality

as the key reason that these projects experienced unexpectedly high overruns. But the factors within these feedback loops are not only hard “concrete” factors: “soft” variables are often important links in the chains of causality and are, thus, critical in determining the project behavior. Such variables might include subjective effects within the workforce, such as morale, schedule pressure, the effects of overtime and overcrowding and so on, as well as the effects caused by the project client (scope changes, delays, interference, lack of client-contractor trust, etc.) or effects caused by management decisions themselves. For example, if multiple changes to a product design cause loss of morale in the design workforce and this leads to decreased productivity and increased error-rates, then a measurable cause has led to measurable effects, but the causal chain relies on a soft factor (“morale”). (Such factors are discussed in [39], [46], and [47], and some empirical phenomenological evidence is described in [45].)

IV. THEORETICAL BASIS OF CONVENTIONAL PROJECT MANAGEMENT

While the results of the systemic modeling work are becoming more widely known, embedding the lessons in project-management practice is not straightforward, because we shall see that it clashes with underlying assumptions within the conventional project-management discourse. It is often said within the project management profession that there is a lack of underlying theory: “Project management lacks a strong theoretical base. Yes, there is an extensive body of knowledge, including many familiar tools and techniques. However, the Project Management BoK is not based on a series of premises, from which a strong, consistent theory is derived, but more on conjecture... Belief that one approach to managing a project will be better than another is still to a large extent based on faith than sound knowledge.” (Turner [49], discussing IPMA work rather than PMI, but equally applicable to both). A PMI-funded review of project management research over the previous 40 years (summarized in [50]) does not mention theory, nor does a PMI report on the future of project management [51]. But is it true that there is no underlying theoretical approach? Due to the historical systems analysis origins of project management outlined above, there are three particular underlying *assumptions* to the various BoKs that need to be drawn out here; while these are discussed relative to the BoKs, they also strongly characterize the dominant discourse in current project management.

The first underlying assumption is that project management is rational (Lundin [52]) and normative (Packendorf [34]). Project management presents itself as self-evidently correct (and, therefore, presumably an explicit espoused theory is not essential), and provides a normative set of techniques. No justification is necessary as there is no question that the BoKs are correct.

Second, the ontological stance (particularly, in the PMBOK) is effectively positivist (as defined by [53]): reality is “out there” and the “facts” of the situation can be observed; further, the observer is independent of what is being observed and can stand back and observe the “real” world objectively. Or at least, using Morgan and Smircich’s [54] spectrum, the PMBOK would take

one of the two “concrete” views of reality, as contrasted by views that the world and “reality” are socially constructed. For example, when performing earned value analysis, each activity is assessed to see how far it has proceeded, deemed to be a concrete reality which can be measured. The APM BoK is similar (although Thiry [55] does include a discussion of sense-making as he interprets projects in a value management framework). Linehan and Kavanagh [56] say that the dominant ontology in project management is a “being” ontology: overemphasizing reification and representation rather than a “becoming” ontology emphasizing sense-making, questioning boundaries. (Although Bredillet [57] suggests that project management *as properly practiced* combines both Comte’s positivist epistemology and a constructivist epistemology incorporating (citing Lemoigne) phenomenological and teleological hypotheses.)

One implication of this stance, according to Hodgson [11], is that although the proponents of project management claim its toolkit to be “universal and politically neutral,” enforcement of project management terminology leads to an imposed ontology and specific way of thinking in a company; he uses Foucauldian analysis to suggest that these claims “serve to establish significant power effects within organizations.” In [15], he says: “The key effect of the application of project management models and techniques is enhanced control over the conduct of employees, based on close surveillance and the limited delegation of discretion to those subjects involved in project work. In particular, the quantification and detailed planning involved in project management serves to “enhance the ‘calculability’” of individuals through developing measures of routine predictability and control” (Metcalfe [58]). This calculability and predictability is largely made possible by the establishment of a generic model for the process of project work, commonly described as the project life cycle, or PLC.” Emphasizing the first assumption, he continues: “This presentation of the PLC as universal, natural and, thus, inevitable does much to undermine resistance to the imposition of associated aspects of project management, including the fragmentation and bureaucratic surveillance of project work” [15].

The third underlying assumption is that project management is particularly concerned with managing scope, and that this “can be managed by decomposing the total work effort into smaller chunks of work” with sequential dependence (Koskela and Howell [59])—giving rise to the standard decomposition models, work breakdown structures and project networks being the two fundamental models. Remington and Crawford [60] say that “the very basis of project management thinking has been reductionist through decomposition.” Soderlund [61] points to two major streams of literature within project management research, one of which essentially looks simply at work breakdown techniques (the other concerns critical success factors). Koskela and Howell [33] go on to show that the theory of the project implicit in this is that of management as transformation of inputs to outputs, and Koskela and Howell [59] add some flesh to these bones by suggesting there are underlying assumptions that tasks are independent (apart from sequential relationships), tasks are discrete and bounded, uncertainty as to requirements and tasks is low, all work is captured by top-down decomposition of the total transformation, and requirements exist at

the outset and can be decomposed along with the work. Clearly, the BoKs do look at integration of the parts, but this is only a small proportion of these documents. (Or putting this into the wider management context, project management discourse clearly tends to lie on the “analyzing” end of Hampden–Turner and Tropenaars’ [62] “analyzing/integrating” scale).

These three assumptions lead to three particular *emphases* in current project management discourse and, thus, in the BoKs.

The first is a heavy emphasis on planning. Planning based on analysis always precedes action (Packendorff [34]). Koskela and Howell [33] show that the management theory implicit in the PMBOK is “management-as-planning” (from [63]); they point out that PMBOK describes one executing process, two controlling processes, but ten planning processes. This is not driven solely by PMI but users: in the PMI’s 2002 “Technical Needs” survey of practitioners, in answer to the question “please indicate the priority that PMI should place into Research and Development in each” (of the five “process groups”), the highest place was given to “Planning,” with an average score of 4.3 on a Likert scale of 1–5, Executing lay last but one with a score of only 3.6 [64] (interestingly, and relevant to the previous assumption, in the same survey Management of Scope also got the highest score of the PMBOK “knowledge areas”). Of the APM “Pathways” [7] seven sets of processes, only one concerns definition and one set planning, but it points out that some of the other sets “need to be enacted for the duration of the project” so they also include significant amounts of planning, still giving a high emphasis on planning (albeit perhaps not quite as high as PMBOK); indeed, it defines how project management achieves its aims “defining what has to be accomplished, generally, in terms of time, cost, and various technical and quality performance parameters; developing a plan to achieve these and then working this plan, ensuring that progress is maintained in line with these objectives; using appropriate project management techniques and tools to plan, monitor, and maintain progress. . .” [7].

Second, and following the emphasis on planning, (and to some extent due to the historical origins of project management mentioned above), there is an implication of a conventional control model, often called the cybernetic-control or thermostat model. Once a project starts, progress and performance are continuously assessed against the Project Plan (epitomized perhaps in the Earned Value concept [65]). This model can be seen, for example, in Harrison’s “control cycle” [66], which shows the following:

“Plan and budget, management decision and resource allocation”	giving instructions to
Project Execution	passing measurements to
Measurements of input & output	passing data to
The Control Analysis	which gives information back to
“Plan and budget.....”	

This is a very traditional model. Hodgson [15], for example, says that: “Most project management textbooks rely on Henri Fayol’s 1916 *Elements of Management* [67] when defining the

specific responsibilities of the Project Manager—planning, organizing, commanding, coordinating, and controlling—despite the trenchant critiques of these principles from a number of writers, particularly, Mintzberg [68].” However, it should be noted that while this model is implicit in the PMBOK, as stated above, the PMBOK’s emphasis is on how to plan rather than how to control.

Third, an emphasis in project management is that it is generally decoupled from the environment. The Project Plan sets out the objectives and motivations of the project, and the Project Manager has to execute the Project Plan (following the management-as-planning philosophy). Clearly, risk management does play a key role in the BoKs (e.g., Pritchard [69]), but the view is fundamentally that the project is to be managed according to the Plan, and that changes to the Plan should be rare and if possible avoided. While it is clearly incorrect now for Morris [70] to point to external risks that Morris and Hough [27] showed were the cause of project failures (client-driven specification changes, weather, geotechnical problems *inter alia*) and say that “few, if any, of these factors are even addressed today in much of the project management literature,” there is clearly a sense in the BoKs in which perturbations or risks are there to be managed away to bring the project back to the Plan. A project is seen as “an ‘island of order’ in the disorderly flux of organizational life” ([71] and [72], quoted in Melgrati and Damiani [73]).

V. SYSTEMIC MODELING VERSUS THE CONVENTIONAL THEORETICAL BASIS

The systemic modeling work provided explanations for why some projects severely overran. But these explanations clash with each of the three assumptions described for the current dominant project management discourse above.

The main clash is with the third assumption. These systemic models show behavior arising from the complex interactions of the various parts of the project. They demonstrate how behavior arises that would *not* be predicted from an analysis of the individual parts of the project and, thus, show how the traditional decomposition models in some circumstances can be inadequate (a view put forward also by Lindkvist *et al.* [74]). Koskela and Howell [33] quote a little empirical evidence that decomposition models do indeed fail to capture the behavior of a whole project, but the systemic modeling work has given more underlying explanations.

The project behavior shown in this body of work is complex and nonintuitive. It shows causal feedback, leading to nonlinear behavior, and produces effects which can sometimes manifest themselves after significant time-delays; and the behavior of such systems is difficult for the human brain to predict and understand intuitively [75]. We found above that the feedback is exacerbated through management response to project perturbations, particularly acceleration, conventional methods providing unhelpful or even disbeneficial advice. Not surprisingly, then, the first assumption is also challenged: project management techniques are not necessarily self-evidently correct, which clearly gives a problem to the normative nature of the BoKs.

The second assumption is also challenged in two ways. First, the models differ from the project management BoKs in their

emphasis on, or inclusion of, “soft” factors, as well as the “concrete” aspects. As discussed above, these “soft” variables can often be important links in the chains of causality that set up feedback loops and, thus, can be critical in determining the project behavior; such variables rarely modeled using conventional project-management methods (partly of course because that they are difficult to quantify)—this means that feedback could not be identified even if conventional methods allowed it. Thomas and Buckle’s analysis [76] suggests that those with masculine traits in management particularly are unlikely to identify and incorporate these “soft effects” into their decision-making, individuals with a strong feminine-trait management style being “sensitive to situations’ emotional context” (see also [77]) and do incorporate such effects; they point to the PMBOK as embodying masculine-style management thinking.

The second challenge to the second assumption is the recognition that the models need to incorporate not only “real” data but management perceptions of data. It was noted above that conventionally, it is assumed that, when performing (say) Earned Value analysis, each activity is assessed to see how far it has proceeded: but this is of course not a concrete reality which can simply be measured but an individual’s interpretation of the state of the activity. The systemic models discussed above try to bring in some consideration of the causes of attitudes and biases and, thus, start to capture the socially constructed nature of “reality” in a project [78].

Since project management’s conventional discourse outlined above and its emphases are derived from the three assumptions, it is reasonable then to look to this body of systemic modeling work to see whether it can begin to offer some explanations as to why the use of project management as conventionally espoused can lead to ineffective management of projects and sometimes even failure—which we shall do in the following section.

VI. WHY DO PROJECTS OVERRUN?

What then do these “systemic” models tell us about why failures occur in projects which might have been well-managed by traditional project-management methods? The key is that the failures analyzed by these methods are in *complex* projects. Williams [79] proposed that project complexity can be characterized by two dimensions, each of which have two subdimensions, and while different authors argue about the definitions and measurement of these dimensions (and the definition of the word “complexity”), the dimensions are well represented throughout the literature:

- structural complexity [80] made up of the size, or number of elements in the project, and the interdependence between these elements; here, the “elements” are particularly organizational (parts of the organization, plants, number of partner companies, the supply chain) but can also reflect the complexity of the work breakdown structure;
- uncertainty, made up of uncertainty in project goals, and uncertainty in the means to achieve those goals [81], [82].

This type of classification is fairly common on the literature [83], [84], and these factors also underlie the general

meaning attributed to “complexity” in practice, as described, for example, in the project categorization work in Crawford *et al.* [85]. It is where these complexity dimensions become important that there are important lessons to be learned from the systemic modeling.

Conventional techniques are clearly designed for projects with large numbers of elements—that is, where the first subdimension for the structural complexity dimension is large. The BoKs assume these elements are related into structures, but the assumed structures are subject to very limited types of interdependence: Work Breakdown structures are hierarchical; critical path activity networks are sequential and so on; systemicity is neglected. For example, the Pathways chapters on scope management, time scheduling and, particularly, resource scheduling deal with a decomposed project with little recognition of systemicity, and even in discussing risk, Davey [86] discusses how to manage individual risks, but the systemic nature of risk structures [87] is not covered. In terms of Thompson’s classical analysis of organizational dependencies [88], the structures allow *pooled* or *sequential* dependencies; However, Thompson’s third type, *reciprocal* dependencies (allowing feedback relationships) is what particularly contributes to complexity (even more so Van de Ven and Ferry’s [89] extension to a fourth type, *iterative coordination*). Shenhar and Dvir’s original typology of projects [90] has roughly the same two dimensions as above (the second is specifically Technological Uncertainty), but in their definition of structural complexity or “scope,” they divide projects into “assembly,” “system,” and “array”; their results clearly differentiate between the different system-element interdependencies implied by these different categories. The systemic modeling work shows that where the interdependence increases, particularly where there are reciprocal dependencies allowing feedback effects to develop, the project will behave in a way difficult to predict intuitively and certainly at variance to how conventional techniques would indicate.

Even more so, conventional methods are unsuited to projects under high uncertainty. The irony of this unsuitability is pointed out by Malgrati and Damiani [73], who contrast “one of the main reasons for the spread of project management in companies, namely, environmental complexity and uncertainty...and exposure to external change” with the philosophical underpinnings of traditional project management methods, concluding “the Cartesian clarity of inner structures clashes with the increasing porosity of projects to complex contexts that they seek to deny (Ulri and Ulri [91]). The risk, in short, is that the idealistic ‘island of order’ may suddenly turn into a more realistic, very classic, ‘iron cage.’” (Again, Thomas and Buckle [76] feel that it is masculine management reasoning which feels responsibility to maintain current plans: “If masculine logic holds great fidelity to initial project plans and objectives, feminine logic has equally great fidelity to real-time conceptualization of what is best for the project and its stakeholders.”) In contrast, the BoKs paint a simple picture of changes to the project plan proposed, agreed, and carried out, and appear hardly to recognize any of the issues arising from a changing environment (e.g., the Pathways book chapter on Change Control [92]).

Goal uncertainty is lacking in the conventional project management discourse, which assumes that there is a clear, unam-

biguous project goal. But, Linehan and Kavanagh [56] claim that: "Projects are complex, ambiguous, confusing phenomena, wherein the idea of a single, clear goal is at odds with the reality." Engwall [93] talks about "the futile dream of the perfect goal," saying that the idea of a clear exogenously defined goal derives from the philosophical origins of project management and is inapplicable for nonrepetitive projects, describing project execution as "a process of goal formation." Kreiner [94] warns against that the risk that "the implied rationalization of the project efforts may in some part sacrifice the relevance of those efforts. . . . 'Best practice' instructs project managers to minimize the risks of ambiguous project goals and inefficient implementations, but to leave the issue of relevance to the assessment of others." He is concerned about "drifting environments," i.e., when a project "somehow diverges from the projected course that formed the premise for the design of the project." In particular, he talks about the "continuous battle over 'spec freeze' versus 'spec float': 'The client is typically portrayed as fighting for his right to keep suggesting additions to, changes in, or new directions for the project, almost up to the time of delivery. The project manager, on the other hand, is said to press for an early 'spec freeze,' since this provides his team with an 'unobstructed task environment.' In this battle, the client is made the guardian of relevance, while the project manager is made the guardian of efficiency."

Conventional methods are heavily based on the "management-as-planning" principle. Johnston and Brennan [63] discuss the underlying assumptions of this principle, in particular, that management draws up plans, and then there is a "largely autonomous causal loop between sensing and acting." They go on to point out that these assumptions "are seldom valid in reasonably complex or changing environments." (Similar warnings in Operations Management were given by Machin and Wilson [95] in 1979 trying to narrow the gap between planning and control, pointing out that planning is artificial, removed from the real situation, whereas control has much less theoretical basis). Remington and Crawford [60] indeed challenge the very notion that control of outcomes is possible or even desirable in a postmodern organization and environment "characterized by fluidity, ambiguity, and uncertainty": "the notion of predetermined outcomes is unrealistic in all but short-term project situations and simple to complicated projects."

It is when uncertainty affects a traditionally managed project that is structurally complex that the systemic effects discussed above start to occur. But there is a third factor that needs to be considered. Frequently, events arise that compromise the plan at a faster rate than that at which it is practical to replan [96]. When the project is heavily time-constrained, so the project manager feels forced to take acceleration actions, this produces the severe problems. A well-planned project that faces no significant outside influences can follow its plan. A project which is structurally simply can be replanned in the face of changes from the outside environment. However, a structurally complex project when perturbed can become unstable and difficult to manage, and under time-constraints dictating acceleration actions when management has to make very fast and sometimes very many decisions, the catastrophic overruns described above can occur. And the underlying idea of the apparently self-evidently cor-

rect set of project management procedures (which cannot cope with such projects) gives no help to project managers. Indeed the existence of a "perfect" model in the BoKs "reinforces the belief that greater formalization can overcome the difficulties of complexity and rapid change" (Hodgson [11]); and Brown [97] claims that the formative context set up by following standard "best practice" is a key part in harming the progress of (in his case, Information Systems) projects.

Now, the statement that a project might overrun because of severe time-constraints appears almost tautologous. And it is well-known that a significant cause of problems in major projects is underestimation caused by political factors that mean that a project would not gain approval otherwise (see the seminal work by Flyvberg *et al.* [98]). However, the systemic modeling work explains *how* the tightness of the time-constraints strengthen the power of the feedback loops, which means that small problems or uncertainties cause unexpectedly large effects; it thus also shows how the type of underspecification identified by Flyvberg brings what is sometimes called "double jeopardy"—underestimation (when the estimate is elevated to the status of a project control budget) causing feedback which causes much greater overspend than the degree of underestimation.

Thus, we have identified the three factors which come together to cause extreme overruns when projects are managed conventionally: *structural complexity*; *uncertainty*, and a *tight time-constraint*. These three *compound*, so the effect of all three is significantly more than any pair on their own. Should we, therefore, abandon conventional project management? To answer this, we need to look at what other possible options there are and how they differ from conventional methodologies.

VII. NEW PROJECT MANAGEMENT STYLES

Recognition of the problems inherent in conventional prescriptive procedures has led to the development of contrasting project management methodologies. This section looks at some of these to see whether they satisfy some of the flaws that the systemic modeling work has identified in the traditional project management discourse, so might be helpful for those projects for which we have identified traditional methods are less applicable.

Molin [99] points out that projects by definition are one off and unique, so perfect planning is impossible. He distinguishes between "the planning approach" to projects (in which a well-defined path to predetermined goals is assumed) and "the learning approach," which "sees the project as an ambiguous task with changing objectives as the project proceeds." Clearly, the BoKs are firmly placed in the first of these approaches, while the second approach appears appropriate for projects exhibiting uncertainty in a Turner and Cochrane [81] sense. (Note that dealing with uncertainty in goals and methods, sometimes also called "ambiguity," is not the same as "project risk management," which as discussed above does lend itself to conventional structured planning as the project manager tries to avoid deviations from the predefined project plan). This second type of approach has given rise to a number of management methodologies in which the project "emerges" rather than being fully preplanned, while being within a strategic

framework. These methodologies are usually identified by words such as “lean” or “agile.” (There are similar suggestions in general management, such as Johnston and Brennan [63]’s suggestion to move from “management-as-planning” to “management-by-organizing,” where “the manager is seen as designer, coordinator, and enabler of otherwise autonomous activities.... Management is seen as organizing things rather than planning or scheduling them.”)

The leading domain for developing agile methods is the software industry, perhaps because of the highly uncertain nature both of its project goals and means. Highsmith [100] describes some well-known techniques such as Adaptive Software Development (which arose out of Rapid Application Development, or RAD), Extreme Programming, and Scrum. All of these are oriented to projects where changes, uncertainty, and ill-defined requirements are pervasive features. In Scrum [101], for example, development takes place over 30-day periods called “sprints,” and daily “scrum” meetings to identify problems and report back on status; there is no predefined activities or work breakdown structure, rather the set of remaining requirements (the “product backlog”) is revisited each month to evaluate remaining work, and at this point the expected project cost and duration is also reestimated. There is evidence that these methods are finding support in practice as they are found to be effective and successful [102]; Charette in an influential Cutter article expounds such methods [103]. At the same time the construction industry, while their projects are not generally subject to the same level of ambiguity as software projects, has also generated some similar “agile” techniques. One such is “Last Planner,” developed by Ballard [104] and described in Koskela and Howell [59]. Activities that “should” be executed have their prerequisites prepared; they then become activities that “can” be executed; and in weekly planning some of these are selected as those that “will” be executed.

These methods all contradict the three underlying emphases of conventional approaches above.

- Contrary to the first emphasis (the heavy emphasis on planning), the project emerges rather than being entirely preplanned; the extent to which plans can be correctly drawn up preproject is limited due to the limited extent of “knowns,” so it is necessary to assume considerable planning and replanning during the project. Action has to begin *without* the project being fully preplanned.
- Contrary to the second emphasis (the implication of a conventional control model), the management style is much more cooperative; there is recognition that the plan prepared preproject is fallible and incomplete, so the manager does not have sufficient knowledge to provide detailed instructions, and also that what the manager commands might not happen as expected, and furthermore, that individuals or groups within the team need to be much more empowered to take part in decision-making.
- Contrary to the third emphasis (project management being decoupled from the environment), there is acceptance that the plan cannot be fully prepared because of the influence of the external environment (in particular, stakeholders such as users and the client), so there is an expectation

that the plan will be developed under the influence of the environment. (Bredillet [78] also identifies the main influences on projects as exogenous).

VIII. DIFFERENT MANAGEMENT STYLES FOR DIFFERENT TYPES OF PROJECTS

PMBOK claims its methods are “applicable to most projects most of the time. This does not mean that the knowledge and practices described are or should be applied uniformly on all projects; the project management team is always responsible for determining what is appropriate for any given project.” [1] The systemic modeling work identified certain types of project for which conventional methods were less appropriate or even counterproductive, giving explanations for why these projects behaved in the way they do and identifying the underlying aspects of the current dominant discourse in project management which clashed with these project characteristics. The previous section has described some alternative project-management styles, which differentiate markedly from conventional methods. So can we differentiate projects for which different techniques would be appropriate?

There have been a number of studies done to categorize projects or attempting a typology of projects with the aim of explaining behavior or identifying different appropriate project management styles for different project types. If we examine this work, we will see that much of it (especially, the latest) comes to a similar conclusion, identifying structural complexity, uncertainty, and pace as the key factors—the extra contribution by the systemic modeling work being that it has given explanations for *why* these classifications are appropriate.

- Shenhar [105] in an empirical study used Shenhar and Dvir’s typology above (dividing by technological uncertainty and scope). Project management styles used were clearly (obviously) dependent on the type of project. Projects with lower technological uncertainty were managed in a formal style; where this was higher, management had to employ a more flexible attitude and tolerance for change and tradeoff between project requirements. System projects required more integration than assembly projects, and so on. But these styles are defined by the types of project and the question of how changing management style would affect project success was left for “further studies.”
- Lewis *et al.* [106] carried out an extensive study of product development projects, and divided project management styles found into disciplined “planned” styles (formal, mechanistic, along conventional lines) and fluid “emergent” styles; the former was blind to the outside environment and, thus, led to stability, the latter style led to creativity. Effective product development they found needed complex mixtures of the two styles.
- Payne and Turner [107], using Turner and Cocharne’s approach [76], said that projects with well-defined goals and methods “lend themselves to activity-based approaches to planning”—i.e., conventional methods. Projects with well-defined goals but for which the method of achieving the goals is the main point of the project (e.g., product

development) they suggest are best dealt with by goal-directed approaches [108]. Where goals are poorly defined but methods are known, then life-cycle-based methods such as Prince [109] are proposed. They do not propose a specific methodology for ill-defined methods and goals.

- Shenhar and Dvir [90], [105] have now been extended to Shenhar and Dvir [110] which postulates a typology based on four dimensions: *complexity*, that is how complex is the product, the task and the organization (structural complexity defined above); *pace*, that is how critical is the time frame (which equates to the time compression above); *novelty*, that is how new is the product in the market; and *technology*, that is, how much new technology is used by the project (which between them would represent major causes of uncertainty). This recognition of pace is important, for the reasons revealed by the systemic modeling work.
- Thomas and Tjäder [111] consider the contradiction of using projects for control in a turbulent environment and also to stimulate learning and creativity. They distinguish two project management models, one close to PMBOK, based on defining and aiming for goals, maximizing winning, being rational; the second based on valid information, commitment to free and informed choice and monitoring its implementation. They differentiate how a project management framework can be imposed by a control paradigm, described mainly through repertoires such as planning, where the project manager seeks to achieve goals by managing tasks and generating control; or by a learning paradigm, influenced by the project manager by communication and motivation, guiding the social processes; or by a mixed paradigm, where a project is what the project manager claims it to be, aiming to meet the client's request at the end; where the manager seeks to understand the interpretation space, guiding perceptions.
- Lindkvist *et al.* [74] uses a matrix of project types based on their systemicity and the extent of learning—closely related to the type and degree of uncertainty in the project; they also reflect on the effect of “pace” in the project.
- De Meyer *et al.* [17] differentiate between projects that exhibit “variation” through those with foreseen uncertainty, unforeseen uncertainty, and finally, chaotic, and propose that these should be managed by a spectrum of methods, with the first of these lending itself to traditional methods and the latter to new approaches that allow for the whole project to change even mid-project. (Note that “unforeseen uncertainty” in this paper can “arise from the unanticipated interaction of many events, each of which might, in principle, be foreseeable,” bringing in the systemicity of risk events.)
- The same authors [18] try to put selection of project-management strategies onto a mathematical basis, distinguishing between “instructionist” (conventional) approaches, “learning” and “selectionist” approaches, the last where learning is ineffective so that the optimum policy is to launch multiple projects simultaneously to find the most successful. Again, the determining factors

to select the best strategy are uncertainty/ambiguity and complexity.

- Besner and Hobbs [112] do not find differences in tools used between different project types; this survey is of PMPs, so may be biased toward those using conventional techniques.
- Is the definition of project success itself linked to the type of project (although the term “success” itself is not well-defined—see [113]–[115])? Shenhar and Wideman [116], using Shenhar and Dvir's structure above, suggest that higher technological uncertainty projects have longer term success criteria. (A low-technological-uncertainty project would have success classically defined as immediate completion on time/cost/specification; for higher uncertainty, overruns are more likely but are aimed to significantly increase short-term effectiveness and give higher benefits in the longer term.) Tatikonda and Rosenthal [117] similarly suggest more sharply defined success criteria than the standard time/cost criteria; their study indicated that increasing technological novelty was related to higher unit-cost and time-to-market results, while project complexity was linked with higher unit-cost.

The systemic modeling work analyzed the reasons for project overruns for many seriously overrun projects (and gives empirical data, albeit on individual projects, on the level of overruns that can result from such effects). The analysis shows *why* certain factors are important and the reasons these can lead to extensive overruns, *why* different types of project require different management techniques and philosophies and *why* the use of inappropriate methods can lead to such extreme project out-turns. The systemic modeling further shows that the behavior of such projects contradicts to some extent all of the three assumptions of the conventional project management discourse. This modeling provides explanations for project behavior deriving from systemic interrelated sets of causal factors, including “soft” variables in the chains of causality, particularly, dynamics set up by these factors turning into positive feedback loops (e.g., rework), with many of the key loops exacerbated through management responses (in particular acceleration). Because the trigger effects occur in complex projects, and it is the response to perturbations caused by uncertainties, in particular, the acceleration needed in a severely time-constrained project, the systemic modeling work arrives at a conclusion showing for which projects conventional methods would be more or less appropriate. The analysis shows that project behavior is complex, counterintuitive, and that the conventional discourse, and the resulting type of project management methods, can be inappropriate and potentially actually disadvantageous for projects that are characterized by three aspects: they are *structurally complex*, *uncertain*, and *heavily time-limited*. Projects which exhibit more of these three aspects are more likely to be inappropriately managed by conventional methods. The literature described in this section has come up with classifications (generally, based either on best practice or dimensions that simply appear appropriate), which are based on similar dimensions to the three quoted above; this work, therefore, backs up the conclusions of the systemic modeling analysis.

IX. DISCUSSION AND CONCLUSION

This paper has looked at the traditionally accepted project management discourse and summarized its underlying character: although it appears to have no theoretical basis, actually (due to some extent to its historical origins) it relies on the assumptions that:

- the methods used are rationalist, self-evidentially correct, and normative;
- a positivist view of ontology is taken;
- project management is about dividing, particularly, the scope of work into smaller pieces and following this, it has particular emphases:
 - on planning rather than execution;
 - on a conventional control model;
 - on managing to a plan, decoupled from the environment.

Then, this paper has looked at the systemic modeling work, which has analyzed the reasons for project overruns for many seriously overrun projects, giving explanations in terms of positive feedback, often exacerbated by management actions, and including both “hard” and “soft” factors in the causal analysis. The analysis has shown that conventional methods can be inappropriate and potentially disadvantageous for projects that are *structurally complex, uncertain, and heavily time-limited*. (Projects that do not satisfy these conditions and are conventionally managed will exhibit the effects identified much less often, which is why the analysis is derived from overrun projects rather than a sample of all projects.)

Projects which exhibit the three characteristics above appear to lend themselves less to conventional methods (indeed, such methods can actually mislead) and newer methods might be more appropriate, such as opposing project-management methods often called “agile” or “lean”.

It has been suggested that Cleland and King (e.g., [8]) began with a systems analysis approach which included the implications of uncertainty and complexity, yet ended up with deterministic normative prescriptions. This paper has not aimed to set up an alternative project-management approach which might end up with a similar contradiction. Rather, the paper is using systemic modeling to give explanations for project behavior, seeing that these explanations clash with the systems analysis approach and, thus, starts to look at when alternative project-management approaches should be considered.

There have been a number of typologies of projects published with the aim of identifying different appropriate project management styles; although not giving reasons for why these dimensions are significant, as the systemic modeling work does, much of this publication comes to a similar conclusion to the above, identifying structural complexity, uncertainty and pace as key factors, backing up the analysis of the systemic modeling.

However, the thesis of this paper is not that we should simply ignore conventional project management methods and move to these opposing techniques. Rather, with the understanding gained from this analysis of the systemic modeling work, we need to move our discourse to take account of the effects encompassed in this work; then we need to categorize projects according to the dimensions which give projects a propensity

for the type of systemic effects, so that an appropriate management style can be specified, in particular an appropriate balance between conventional methods as espoused in the BoKs and these contrasting methods. While this paper has taken the systemic modeling work, given explanations for project behavior and in particular extreme out-turns, and shown how these explanations differ from the dominant project management discourse, three pieces of further work are required.

- First, we need to define metrics for the three dimensions discussed above which give projects a propensity for systemic effects, structural complexity, uncertainty, and severe time-limitation. While a little work has been undertaken to give operational measures to the first of these (e.g. [79] and [105]), and de Meyer *et al.* [17] suggest selecting the management strategy based on such parameters, there has been little success so far in quantifying these attributes.
- Second, we need to develop ways in which the contrasting underlying philosophies of project management (to take one example, “maintaining the project plan” versus “constant replanning”) can be mixed (Thomas and Tjäder [111] have perhaps provided a starting point).
- Third, we need to see how the “best” mix of approaches can be defined dependent upon the project metrics (“best” being the one most likely to lead to project “success,” the definition of which might itself be contingent upon the project characteristics).

This sets the next stage of the research agenda for project analysts.

We started this paper with questions. What makes projects behave in a different way from our expectations? What is wrong with our project management theory? And how should managers manage projects differently? We have shown how systemic project modeling gives one explanation for project behavior, and how it clashes with the underlying assumptions and emphases of the dominant project-management discourse. The third question, however, needs further research to give a complete answer.

REFERENCES

- [1] *A Guide to the Project Management Body of Knowledge (PMBOK)*. Newtown Square, PA: Project Management Inst., 2000.
- [2] D. A. Buchanan and D. Boddy, *The Expertise of the Change Agent: Public Performance and Backstage Activity*. London, U.K.: Prentice-Hall, 1992.
- [3] *The Handbook of Project-Based Management*, ser. Henley Management, McGraw-Hill, New York, 1993. J. R. Turner.
- [4] M. Dixon, Ed., *The Association for Project Management (APM) Body of Knowledge (BoK)*, 4th ed. High Wycombe, U.K.: Assoc. Project Management, 2000.
- [5] M. Stevens, *Project Management Pathways*. High Wycombe, U.K.: Assoc. Project Management, 2002.
- [6] B. Johnson, B. Saunders, and M. Stevens, *The Pathways Concepts and BOK*, 2002. in M. Stevens, *Project Management Pathways*, High Wycombe, U.K.: Assoc. Project Management.
- [7] M. Holton, *Project Management*, 2002. in M. Stevens, *Project Management Pathways*, High Wycombe, U.K.: Assoc. Project Management.
- [8] D. I. Cleland and W. R. King, *Systems Analysis and Project Management*. New York, NY: McGraw-Hill, 1967.
- [9] *Project Management Handbook*, Van Nostrand, New York, 1983. D. I. Cleland, W. R. King.
- [10] P. W. G. Morris, *The Management of Projects*. London, U.K.: Thomas Telford, 1994, pp. 213–217.

- [11] D. E. Hodgson, "Disciplining the professional: The case of project management," *J. Manage. Stud.*, vol. 39, pp. 803–821, 2002.
- [12] R. Lundin and F. Hartman, Eds., *Projects as Business Constituents and Guiding Motives*. Dordrecht, Holland: Kluwer, 2000.
- [13] R. Lundin and C. Midler, Eds., *Projects as Arenas for Renewal and Learning Processes*. Dordrecht, Holland: Kluwer, 1998.
- [14] K. Sahlin-Andersson and A. Soderholm, Eds., *Beyond Project Management: New Perspectives on the Temporary-Permanent Dilemma*. Copenhagen, Sweden: Copenhagen Bus. School Press, 2002.
- [15] D. E. Hodgson, "Project work: The legacy of bureaucratic control in the post-bureaucratic organization," *Organization*, vol. 11, pp. 81–100, 2004.
- [16] G. M. Winch, N. Clifton, and C. Millar, "Organization and management in an Anglo-French consortium: The case of transmanche-link," *J. Manage. Stud.*, vol. 37, pp. 663–685, 2000.
- [17] A. De Meyer, C. H. Loch, and M. T. Rich, "Managing project uncertainty: From variation to chaos," *MIT Sloan Manage. Rev.*, vol. 43, no. 2, pp. 60–67, 2002.
- [18] M. T. Rich, C. H. Loch, and A. De Meyer, "On uncertainty, ambiguity and complexity in project management," *Manage. Sci.*, vol. 48, pp. 1008–1023, 2002.
- [19] R. Deshpande and F. E. Webster, "Organizational culture and marketing: Defining the research agenda," *J. Marketing*, vol. 53, pp. 3–15, 1989.
- [20] R. Harrison, "How to describe your organization," *Harv. Bus. Rev.*, vol. 5, pp. 119–128, May/June 1972.
- [21] C. Handy, *Understanding Organizations*, 4th ed. London, U.K.: Penguin, 1993.
- [22] E. S. Andersen, "Understanding your project organization's character," *Proj. Manage. J.*, vol. 34, pp. 4–11, 2003.
- [23] G. Hofstede, *Culture's Consequences: Comparing Values, Behaviors, Institutions and Organizations Across Nations*, 2nd ed. Thousand Oaks, CA: Sage, 2001.
- [24] G. M. Winch, C. Millar, and N. Clifton, "Culture and organization: The case of transmanche-link," *Brit. J. Manage.*, vol. 8, pp. 237–249, 2000.
- [25] N. Muriithi and L. Crawford, "Approaches to project management in Africa: Implications for international development projects," *Int. J. Proj. Manage.*, vol. 21, pp. 309–319, 2004.
- [26] D. A. Buchanan, "Vulnerability and agenda: Context and process in project management," *Brit. J. Manage.*, vol. 2, pp. 121–132, 1991.
- [27] P. W. G. Morris and G. H. Hough, *The Anatomy of Major Projects: A Study of the Reality of Project Management*. New York: Wiley, 1987.
- [28] "Ministry of Defence: Control and management of the development of major equipments," National Audit Office, HMSO, London, U.K., Rep. Comptroller and Auditor General 568, 1986.
- [29] G. W. Arbogast and N. K. Womer, "An error components model of cost overruns and schedule slip on army R&D programs," *Nav. Res. Log.*, vol. 35, pp. 367–382, 1988.
- [30] T. M. Williams, "A classified bibliography of research relating to project risk," *Eur. J. Opl. Res.*, vol. 85, pp. 18–38, 1995.
- [31] D. W. M. Chan and M. M. Kumaraswamy, "A comparative study of causes of time overruns in Hong Kong construction projects," *Int. J. Proj. Manage.*, vol. 15, pp. 55–64, 1997.
- [32] B. Flyvberg, M. K. Holm, and S. L. Buhl, "Understanding costs in public works projects: Error or lie?," *J. Amer. Plan. Ass.*, vol. 68, pp. 279–295, 2002.
- [33] L. Koskela and G. Howell, "The underlying theory of project management is obsolete," in *Proc. PMI Res. Conf., Proj. Manage. Inst.*, Seattle, WA, 2002, pp. 293–301.
- [34] J. Packendorff, "Inquiring into the temporary organization: New directions for project management research," *Scand. J. Manage.*, vol. 11, pp. 319–333, 1995.
- [35] H. A. Simon, *Sciences of the Artificial*, 2nd ed. Cambridge, MA: MIT Press, 1982.
- [36] K. Cooper, "Naval ship production: A claim settled and a framework built," *Interfaces*, vol. 10, pp. 20–36, 1980.
- [37] A. K. Graham, "Beyond PM 101: Lessons for managing large development programs," *Proj. Manage. J.*, vol. 31, pp. 7–18, 2000.
- [38] F. Ackermann, C. Eden, and T. Williams, "Modeling for litigation: Mixing qualitative and quantitative approaches," *Interfaces*, vol. 27, pp. 48–65, 1997.
- [39] T. M. Williams, F. R. Ackermann, and C. L. Eden, "Structuring a disruption and delay claim," *Eur. J. Opl. Res.*, vol. 148, pp. 192–204, 2003.
- [40] A. Rodrigues and J. A. Bowers, "System dynamics in project management: A comparative analysis with the traditional methods," *Syst. Dyn. Rev.*, vol. 12, pp. 121–139, 1996.
- [41] K. Cooper, J. M. Lyneis, and B. J. Bryant, "Learning to learn, from past to future," *Int. J. Proj. Manage.*, vol. 20, pp. 213–219, 2002.
- [42] D. R. Friedrich, J. P. Daly, and W. G. Dick, "Revisions, repairs and rework on large projects," *J. Constr. Eng. Manage.*, vol. 113, pp. 488–500, 1987.
- [43] K. Cooper, "The rework cycle: Benchmarks for the project manager," *Proj. Manage. J.*, vol. 20, pp. 17–21, 1993.
- [44] J. M. Lyneis, K. G. Cooper, and S. A. Els, "Strategic management of complex projects: A case study using system dynamics," *Syst. Dyn. Rev.*, vol. 17, pp. 237–260, 2001.
- [45] C. Eden, F. Ackerman, and T. Williams, "The amoebic growth of project costs," *Proj. Manage. J.*, 2004, submitted for publication.
- [46] T. M. Williams, C. L. Eden, F. R. Ackermann, and A. Tait, "Vicious circles of parallelism," *Int. J. Proj. Manage.*, vol. 13, pp. 151–155, 1995.
- [47] C. Eden, T. Williams, F. Ackermann, and S. Howick, "On the nature of disruption and delay (D&D) in major projects," *J. Opl. Res. Soc.*, vol. 51, pp. 291–300, 2000.
- [48] M. Stevens, *Project Context*, 2002. In M. Stevens, *Project Management Pathways*, High Wycombe, U.K.: Assoc. Project Management.
- [49] J. R. Turner, "Editorial. project management: A profession based on knowledge or faith?," *Int. J. Proj. Mgmt.*, vol. 17, pp. 329–330, 1999.
- [50] T. J. Kloppenborg and W. A. Opfer, "The current state of project management research: Trends, interpretations, and predictions," *Proj. Manage. J.*, vol. 33, pp. 5–18, 2002.
- [51] *The Future of Project Management*. Newtown Square, PA: Project Manage. Inst., 1999.
- [52] R. A. Lundin, "Editorial: Temporary organizations and project management," *Scand. J. Manage.*, vol. 11, pp. 315–317, 1995.
- [53] P. Johnson and J. Duberley, *Understanding Management Research*. London, U.K.: Sage, 2000.
- [54] G. Morgan and L. Smircich, "The case for qualitative research," *Acad. Manage. Rev.*, vol. 5, pp. 491–500, 1980.
- [55] M. Thiry, *Value Management*, 2002. In M. Stevens, *Project Management Pathways*, High Wycombe, U.K.: Assoc. Project Management.
- [56] C. Linehan and D. Kavanagh, "From project ontologies to communities of virtue," presented at the 2nd Int. Workshop Making Projects Critical, Bristol, U.K., Dec. 13–14, 2004.
- [57] C. N. Bredillet, "Beyond the positivist mirror: Toward a project management 'gnosis'," in *Proc. IRNOP Conf.*, Turku, Finland, Aug. 2004, pp. 70–94.
- [58] B. Metcalfe, "Project management system design: A social and organizational analysis," *Int. J. Prod. Econ.*, vol. 52, pp. 305–316, 1997.
- [59] L. Koskela and G. Howell, "The theory of project management: Explanation to novel methods," in *Proc. 10th Annu. Conf. Lean Construct., IGLC-10*, Gramado, Brazil, Aug. 2002.
- [60] K. Remington and L. Crawford, "Illusions of control: Philosophical foundations for project management," in *Proc. IRNOP Conf.*, Turku, Finland, Aug. 2004, pp. 563–577.
- [61] J. Soderlund, "On the development of project management research: Schools of thought and critique," *Int. Proj. Manage. J.*, vol. 8, pp. 20–31, 2002.
- [62] C. Hampden-Turner and F. Tropaars, *The Seven Cultures of Capitalism*. New York: Doubleday, 1993.
- [63] R. B. Johnston and M. Brennan, "Planning or organizing: The implications of theories of activity for management of operations," *OMEGA*, vol. 24, pp. 367–384, 1996.
- [64] H. Stefanou, "Research program overview," in *Proc. Res. Progr. Open Session, PMI Global Congr.*, Baltimore, MD, Sep., 21st 2003.
- [65] Q. W. Fleming and J. M. Koppelman, *Earned Value Project Management*, 2nd ed. Newtown Square, PA: Project Manage. Inst., 2000.
- [66] F. Harrison, *Advanced Project Management*. Gower, Aldershot, U.K., 1985.
- [67] H. Fayol, *General and Industrial Management*. London, U.K.: Pitman, 1916.
- [68] H. Mitzberg, *The Nature of Managerial Work*. New York: Harper & Row, 1973.
- [69] C. L. Pritchard, *Risk Management: Concepts and Guidance*, 2nd ed. Arlington, VA: ESI Int., 2001.
- [70] P. W. G. Morris, "Science, objective knowledge and the theory of project management," in *Proc. Inst. Civ. Eng.*, vol. 150, May 2002, pp. 82–90.
- [71] F. A. Dubinski, "On the edge of chaos: A metaphor for transformative change," *J. Manage. Enquiry*, vol. 3, pp. 355–366, 1994.
- [72] J. Lampel, "Editorial: Toward a holistic approach to strategic project management," *Int. J. Proj. Manage.*, vol. 19, pp. 433–435, 2001.
- [73] A. Malgrati and M. Damiani, "Rethinking the new project management framework: New epistemology, new insights," in *Proc. PMI Res. Conf., Project Manage. Inst.*, Seattle, WA, 2002, pp. 371–380.

- [74] L. Lindkvist, J. Soderlund, and F. Tell, "Managing product development projects: On the significance of fountains and deadlines," *Org. Stud.*, vol. 19, pp. 931–951, 1998.
- [75] J. D. Sterman, "Modeling of managerial behavior: Misperceptions of feedback in a dynamic decision making experiment," *Manage. Sci.*, vol. 35, pp. 321–339, 1989.
- [76] J. Thomas and P. Buckle, "Living in the white spaces between the lines: Exploring the use of gendered logic systems in project managers' discourse," in *Proc. IRNOP Conf.*, Turku, Finland, Aug. 2004, pp. 620–641.
- [77] A. Eagly and B. Johnson, "Gender and leadership style: A meta-analysis," *Psych. Bull.*, vol. 111, pp. 233–256, 1990.
- [78] C. N. Bredillet, "Understanding the very nature of project management: A praxiological approach," in *Proc. PMI Res. Conf.*, London, U.K., Jul. 2004.
- [79] T. M. Williams, "The need for new paradigms for complex projects," *Int. J. Proj. Manage.*, vol. 17, pp. 269–273, 1999.
- [80] D. Baccarini, "The concept of project complexity—A review," *Int. J. Proj. Manage.*, vol. 14, pp. 201–204, 1996.
- [81] J. R. Turner and R. A. Cochrane, "Goals-and-methods matrix: Coping with projects with ill defined goals and/or methods of achieving them," *Int. J. Proj. Manage.*, vol. 11, pp. 93–102, 1993.
- [82] *All Change—The Project Manager's Secret Handbook*, Financial Times Manage., London, U.K., 1996. E. Obeng.
- [83] D. Milosevic, *Project Management Toolbox: Tools and Techniques for the Practicing Project Manager*. New York: Wiley, 2003.
- [84] N. P. Archer, "Project management in network organizations," in *Proc. PMI Res. Conf.*, London, U.K., Jul. 2004.
- [85] L. Crawford, J. B. Hobbs, and J. R. Turner, "Project categorization systems and their use in organizations: An empirical study," presented at the PMI Res. Conf., London, U.K., Jul. 2004.
- [86] K. Davey, Risk Management, 2002. in M. Stevens, *Project Management Pathways*, High Wycombe, U.K.: Assoc. Project Management.
- [87] T. M. Williams, F. R. Ackermann, and C. L. Eden, "Project risk: Systemicity, cause mapping and a scenario approach," in *Managing Risks in Projects*, K. Kahkonen and K. A. Artto, Eds. London, U.K.: E&FN Spon, 1997, pp. 343–352.
- [88] J. D. Thompson, *Organizations in Action*. New York, NY: McGraw-Hill, 1967.
- [89] A. H. Van de Ven and D. Ferry, *Measuring and Assessing Organizations*. New York: Wiley, 1980.
- [90] A. J. Shenhar and D. Dvir, "Toward a typological theory of project management," *Res. Policy*, vol. 25, pp. 607–632, 1996.
- [91] B. Ulri and D. Ulri, "Le management de projets et ses evolution en Amerique du Nord," *Revue Francaise de Gestion*, vol. 129, pp. 21–31, 2000. (Juin-Juillet-Aout), quoted in Malgrati and Damiani (2002) above.
- [92] D. Lock, *Change Control*, 2002. in M. Stevens, *Project Management Pathways*, High Wycombe, U.K.: Assoc. Project Management.
- [93] M. Engwall, "The futile dream of the perfect goal," *Beyond Project Management: New Perspectives on the Temporary-Permanent Dilemma*, pp. 261–277, 2002.
- [94] K. Kreiner, "In search of relevance: Project management in drifting environments," *Scand. J. Manage.*, vol. 11, pp. 335–346, 1996.
- [95] J. L. J. Machin and L. S. Wilson, "Closing the gap between planning and control," *Long Range Plan.*, vol. 1, pp. 16–32, 1979. q2.
- [96] J. E. Ashton, M. D. Johnson, and F. X. Cook, "Shop floor control in a system job shop: Definitely not MRP," *Prod. Inv. Manage. J.*, vol. 31, pp. 27–32, 1990.
- [97] P. Brown, "A cure that harms? The enactment of project management on IS projects," presented at the 2nd International Workshop, Bristol, U.K., Dec. 13–14th, 2004. making projects critical.
- [98] B. Flyvberg, N. Bruzelius, and W. Rothengatter, *Megaprojects and Risk: An Anatomy of Ambition*. Cambridge, Cambridgeshire, U.K.: Cambridge Univ. Press, 2003.
- [99] K. Molin, "Divided loyalties in project management," in *Proc. 3rd Eur. Acad. Manage. Conf.*, Milan, Italy, Apr. 2003, . .
- [100] J. Highsmith, *Agile Software Development Ecosystems*. Boston, MA: Addison-Wesley, 2002.
- [101] K. Schwaber, M. Needle, and R. C. Martin, *Agile Software Development with SCRUM*. Upper Saddle River, NJ: Prentice-Hall, 2001.
- [102] N. Udo and S. Koppensteiner, "Will agile development change the way we manage software projects? AGILE from a PMBOK guide perspective," in *Proc. PMI Global Congr., Project Manage. Inst.*, Baltimore, MD, Sep. 22–23, 2003.
- [103] R. N. Charette, "Challenging the fundamental notions of software development," Cutter Consortium, Executive Rep., vol. 4, 2003.
- [104] G. Ballard, "The last planner system of production control," Ph.D. dissertation, School of Civil Eng., Univ. Birmingham, Birmingham, U.K., 2000.
- [105] A. J. Shenhar, "One size does not fit all projects: Exploring classical contingency domains," *Manage. Sci.*, vol. 47, pp. 394–414, 2001.
- [106] M. W. Lewis, M. A. Welsh, G. E. Dehler, and S. G. Green, "Product development tensions: Exploring contrasting styles of project management," *Acad. Manage. J.*, vol. 45, pp. 546–564, 2002.
- [107] J. H. Payne and J. R. Turner, "Company-wide project management: The planning and control of programmes of projects of different type," *Int. J. Proj. Manage.*, vol. 17, pp. 55–59, 1998.
- [108] E. S. Andersen, K. V. Grude, and T. Hague, *Goal Directed Project Management*, 2nd ed. London, U.K.: Kogan Page, 1995.
- [109] CCTA, "Managing successful projects with PRINCE2," ISBN 011 330 855 8, 1998.
- [110] A. J. Shenhar and D. Dvir, "How project differ and what to do about it," in *Handbook of Managing Projects*, J. Pinto and P. Morris, Eds. New York: Wiley, 2004.
- [111] J. L. Thomas and J. Tjäder, "On learning and control—Competing paradigms or co-existing requirements for managing projects in ambiguous situations?," presented at the Proc. IRNOP, Sydney, NSW, Australia, 2000.
- [112] C. Besner and B. Hobbs, "An empirical investigation of project management practice: In reality, which tools do practitioners use?," in *Proc. PMI Res. Conf.*, London, U.K., Jul. 2004.
- [113] J. K. Pinto, "The elements of project success," in *Field Guide to Project Management*, D. I. Cleland, Ed. New York: Van Nostrand, 1998, pp. 13–21.
- [114] J. K. Pinto and D. P. Slevin, "Critical success factors across the project life cycle," *Proj. Manage. J.*, vol. 19, pp. 67–75, 1998.
- [115] J. R. Turner, Project Success Criteria, 2002. in M. Stevens, *Project Management Pathways*, High Wycombe, U.K.: Assoc. Project Management.
- [116] A. J. Shenhar and R. M. Wideman, "Improving PM: Linking success criteria to project type," presented at the Southern Alberta Chapter, Project Management, Newtown Square, PA, May 1996.
- [117] M. V. Tatikonda and S. R. Rosenthal, "Technology novelty, project complexity, and project development project execution success: A deeper look at task uncertainty in product innovation," *IEEE Trans. Eng. Manage.*, vol. 47, no. 1, pp. 74–87, Feb. 2000.



Terry Williams was educated at the University of Oxford, Oxford, U.K., and the University of Birmingham, Birmingham, U.K. He received the Ph.D. degree from University of Birmingham in 1983.

He worked for nine years in Operations Research at Engineering Consultants YARD (now within BAE Systems), developing project risk management work, and later acting as Risk Manager for major projects. He (re)joined Strathclyde University, Glasgow, U.K., in 1992 and is now Professor of Operational Research and Head of the Management Science Department.

He is one of a team which has supported major post-project claims, particularly, Delay and Disruption, totaling over \$1.5 billion in Europe and North America. He continues to advise on project risk, and feels it is important to use real post-mortem analysis to help guide future projects. He is a speaker on project management. He has written around 50 articles in refereed Operations Research and Project Management journals. He authored *Modeling Complex Projects* (New York, Wiley, 2002). He is an editor of a learned journal. He continues research and independent consultancy modeling the behavior of major projects.

Prof. Williams is a Project Management Professional (PMP), Chartered Mathematician, and a Fellow of two Institutes.