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Towards project management 2.0

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Project management approaches derived from best practices in the defence/aerospace, construction and pharmaceutical industries during the early 1970s have proven effective for managing small numbers of large projects in the relatively stable political, economic and technological context of the post-World War II period. However, the detailed, centralized planning, decentralized execution and centralized control of large projects that are the basis of these 'PM 1.0' methods and tools have proven burdensome and unresponsive for a new generation of workers who have grown up in a Web 2.0 world and who are now working on cutting-edge projects with rapidly evolving technologies in today's extremely dynamic global markets and political economies. A new set of 'PM 2.0' methods, tools and governance arrangements were pioneered for rapid product development and have recently been adapted for agile software development. They are based on a radically different project management philosophy for dealing with these new contingencies. This paper reviews the origins of PM 1.0 to explain why it was a valid approach for the latter half of the twentieth century; explains why the key assumptions underlying this method are frequently no longer valid; describes some of the key elements of evolving PM 2.0 approaches to project management in industries ranging from 'software in the cloud' development to special operations in the US military and discusses the kinds of tools, employee training and human resources practices that will need to evolve to support PM 2.0 for the ever more dynamic and unpredictable projects of the twenty-first century. This paper concludes with a discussion of the limitations of PM 2.0 and a set of key questions that will need to be answered through future research before the PM 2.0 approach can become more widely adopted for managing engineering project organizations.

Keywords: Agile management, agile software development, agility, command-and-control, decentralization, discipline, governance, human resources management, lean management, Power to the Edge, project management, Project Enterprise, project management body of knowledge, participative management, responsiveness, small group dynamics, Web 2.0

Introduction

Since personal computers began to diffuse into the workplace in the early 1980s, information technology has dramatically reshaped all forms of work. At the same time, the nexus of low-cost computing, low-cost storage and widely accessible, low-cost broadband data transmission has massively reshaped business, social and political interactions in ways that we are just beginning to understand. In the current, decentralized, always-on, 'Web 2.0' world, many project managers are still using the 1960s 'PM 1.0' top-down style of project management that was formalized by the founders of the Project Management Institute (PMI) in the early 1970s to plan and execute their projects. This PM 1.0 style of project management assumes that planners can develop a detailed plan that will remain a valid baseline plan for the duration of even the most complex, decade-long project. First-line managers and workers will then commit to meet the deliverables in this plan, execute the project in accordance with the plan, report any variances from the detailed plan to management and have management help them find ways to bring the project work processes and outputs back into compliance with the plan.

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PM 1.0 was developed to bring order and discipline to large teams of specialists engaged in a joint effort. They rested on the implicit assumption that the world was predictable and stable enough and that technologies for the development of projects such as dams, highways, pharmaceuticals aerospace/defence were well enough understood that a 'good plan' developed by knowledgeable planners would remain a good plan for the duration of the project. Our PM 1.0 methods, tools and project organization cultures have largely taken this model of project management for granted, while the Internet-enabled worldview of today's knowledge workers has been evolving under our feet, and key project assumptions that underlie our project plans are changing ever more rapidly in every dimension—technically, financially, politically, socially and even climatologically.

An equally dramatic revolution in interpersonal and mass communication has been occurring since the late 1990s. Before the personal computer and smart phone world, information for mass consumption was created by experts, reviewed by 'editors', published at scheduled intervals in print, radio and television media by large corporate or government 'publishers' and 'received' by more or less passive readers—aside from the occasional irate 'letter to the editor' or call in to a talk show. The Web 2.0 world has turned this model of top-down 'broadcast communications' upside down. Information-rich media content of all kinds is now created by anybody with a laptop computer or smart mobile phone, shared many to many in real time as locally salient events unfold, and rated and edited by popular vote of all of the other readers and creators of like content—think of billions of viewers rating *YouTube* videos or the *American Idol* audience voting for their favourite idol. The ramifications of this seismic shift in information creation, distribution and evaluation for corporate communication, political censorship—and project management—are profound. However, they are barely understood by most current project managers, and they have been hugely underutilized as a force for more effective project management in a more dynamic world with Web 2.0 workers.

One can begin to see the emergence of a new, radically decentralized, participative and empirical style of PM 2.0 in some sectors of the economy such as software development, where software teams are beginning to use more agile approaches than the traditional 'Waterfall' PM 1.0 software development method, for example, the *ScrumMaster* approach popularized by Schwaber and Beedle (2001). However, the traditional practitioners of project management—construction, aerospace/defence and pharmaceuticals—have not yet begun to take advantage of these trends to any significant degree, with a few notable exceptions. This paper reviews the origins of PM 1.0 to explain why it was a valid approach for the latter half of the twentieth century; explains why the key assumptions underlying this method are frequently no longer valid; describes some of the key elements of evolving PM 2.0 approaches to project management in industries ranging from 'software in the cloud' development to special operations in the US military and discusses the kinds of tools, employee training and human resources practices that will need to evolve to support PM 2.0 for the ever more dynamic and unpredictable projects during the twenty-first century.

PM 2.0 will be illustrated using a case study of Salesforce.com, a US software company whose agile approach to creating Customer Relationship Management (CRM) software, delivered via web browsers and computed and stored 'in the cloud', demolished traditional enterprise CRM software competitors such as Siebel. A second example will be drawn from the US Defense Department's 'Power to the Edge' philosophy of network-centric, asymmetric warfare. Early attempts made to harness the elements of PM 2.0 via integrated project delivery (IPD) of constructed facilities such as Heathrow Terminal Five and several hospitals built for Sutter Health in the USA over the last few years, using a combination of lean management and PM 2.0 principles and techniques, will also be briefly discussed.

Traditional project management—PM 1.0

Project management has been practised in one form or another since agriculture first allowed humans to congregate relatively permanently in villages and cities where they needed to coordinate the activities of multiple participants to complete tasks such as building water supply systems and storehouses for grain, erecting religious edifices and constructing roads and ports. This section reviews the origins, philosophy, strengths and weaknesses of the 'PM 1.0' approach derived from project experience over the last five millennia that is still employed on many projects today.

Origins of PM 1.0

The PMI was founded in 1969 by project mangers drawn primarily from defence/aerospace, construction and pharmaceutical industries. Several historians of project management (e.g. Kozak-Holland 2010; Wikipedia 2011) have argued that the nine core methods and tools derived from best practices in these industries during the 1940s through early 1960s and subsequently formalized in PMI's 'project management body of knowledge' (PMBOK) have been used—albeit intuitively—since the time of the construction of the pyramids in Egypt, the complex buildings and waterworks of

Machu Picchu, the Great Wall of China and other ancient structures. Kozak-Holland (2010) stated that

> The History of Project Management is the history of mega projects of the last 4,500 years that include the Giza Pyramid, the Parthenon, the Colosseum, the Gothic Cathedrals of Europe, the Taj Mahal and the Transcontinental Railway. These were not anomalies in history but projects delivered in a systematic way with very similar characteristics to today's projects. …

The tried-and-true PM 1.0 techniques that had evolved over millennia still proved effective for managing large projects in the relatively stable political, economic and technological contexts that existed in the USA and Europe during the post-World War II period through the end of the 1980s. We examine the management philosophy underlying these techniques next.

Intrinsic managerial philosophy underlying PM 1.0

The conceptual design phase of projects has long been carried out by relatively experienced engineers and managers using whiteboards, flip charts and post-it notes or, more recently, using flexible 3D CAD modelling and conceptual design and estimating software. Once the outline of the project and its key components has been established, larger teams of relatively more junior professional planners with titles such as 'estimators', 'cost engineers', 'schedule engineers' and 'quality control engineers' develop detailed baseline plans and estimates, extending to tens of thousands or even hundreds of thousands of activities and cost codes for projects such as nuclear power plants. Large teams of 'implementers', who may or may not have been involved in planning the projects, then try to execute these plans.

The intrinsic—but usually implicit—philosophy underlying the 'PM 1.0' PMBOK approach to project management is that a small number of experienced and knowledgeable project planners should carry out centralized planning for projects in considerable detail. This detailed plan defines a 'baseline plan' for the way the project should then be executed and delineates a set of project output metrics (in terms of scope, resources and schedule) for its successful completion. Any deviation from the baseline project plan should be regarded as a 'variance' or 'exception' that needs to be corrected. That is, the project tasks and resources should be continually realigned, as needed, to make project execution conform as closely as possible to the details of the 'good' baseline project plan for the project to achieve 'success'. In effect, this approach to project management makes the implicit assumption that 'The baseline plan was, is, and will remain, a good and valid plan'.

If all key project participants have participated in developing the implementation approaches and targets in the baseline plan and can commit to achieving them, the plan also serves as the benchmark for evaluation of all participants' performance in the project. Holding firm to the baseline plan thereby motivates all participants to make whatever efforts are necessary in order to achieve the performance targets defined in the overall plan. PM 1.0 assumes that planners have the wisdom and foresight to develop detailed plans and performance targets that are feasible to implement and achieve, respectively, and that they will remain valid for the entire execution period—which can exceed a decade for large defence, civil infrastructure or drug development projects. We address some of the key challenges that these elements of PM 1.0 raise for modern projects in the following section.

Challenges of centralized planning and decentralized execution

There are several key challenges associated with this approach to detailed project planning:

(1) The planners who develop the multi-thousand activity project networks and cost codes are often recent graduates who know how to use project planning tools, but have relatively low levels of construction or manufacturing experience. Thus, plans may not be realistic and feasible to implement in terms of real-world project execution constraints.
(2) When the world is changing fast enough that one or more key assumptions in the plan may become invalid over time, the validity of the baseline plan —even if it was developed by experts with a great deal of execution experience—immediately begins to erode. In situations such as this, a detailed plan that is constantly changing, and is also serving as the basis for all kinds of performance incentives, becomes a hindrance to the project rather than a help—a virtual ball and chain around the legs of people trying to get the project completed.[1]

[1]The author was involved in the construction of nuclear power plants in the mid-1970s, when the US Nuclear Regulatory Commission was still in the process of developing its regulations, so that design requirements for items such as pipe supports were continually changing. The author was present in one meeting where a change in the regulations had just been promulgated requiring the removal and reinstallation of thousands of pipe supports that had been installed the previous week. The professional planners in the room stated that they needed a week to update the plan, so the removal of old pipe supports and construction of the new ones should be halted until they could develop a new baseline plan. Talk about the tail wagging the dog!

(3) In PM 1.0, baseline plans become fixed targets against which the performance of the execution team will be judged. When the execution team is not involved in developing the baseline plan, execution team members may not feel committed to achieving the targets in the baseline plan. Instead of striving to meet targets when variances from this 'unrealistic' plan occur, they may look for external events to which they can attribute the variance, so as to evade personal responsibility. Another second result has been that status reports tend to be overly optimistic, with project managers concealing variances hoping that they can correct them before senior management discovers them. And nasty surprises are only revealed late in the project, when the 'variances' have spun out of control and can no longer be corrected.

(4) Finally, workers who are given a detailed plan and told to execute it with no variance from the plan's target outputs are denied the opportunity to use their own creativity to think of ways in which they could impact the high-level strategic outcomes for which the project's target outputs are just the planners' proxies. This creates a communication gap between executives who develop strategy in organizations and the project teams who execute key elements of that strategy. The motivational impacts of this gap on new 'Web 2.0' workers entering the workforce will be discussed in a subsequent section.

Strengths and weaknesses of PM 1.0

PM 1.0 is disciplined

In a world with relatively stable economic and political conditions, mature technologies, ample resources, a relatively predictable climate and no major contingencies beyond the control of project participants, PM 1.0 has provided a disciplined and effective way to plan and execute many of the most challenging and complex military, aerospace, construction and pharmaceutical projects since the 1970s. It has facilitated the delegation and, often, the contractual outsourcing of authority for program and project execution to large teams of specialists while creating accountability for execution of individual components of the project through commitment of each specialist team to achieving the output targets in its baseline plan. Engineers and managers from the time of the Pyramids of Giza to the Hoover Dam and the Apollo Moon Landing have used this project management philosophy successfully to deliver remarkable technological and scientific outcomes. Moreover, some of today's large and complex projects satisfy the same kinds of assumptions about relatively predictable contexts and unchanging assumptions over the duration of the project, so that PM 1.0 still remains a valuable management discipline for many projects.

Moreover, the discipline of PM 1.0 forces a team to produce detailed specifications and to ensure that rigorous testing and documentation are done—for example, by pharmaceutical firms planning clinical trials to obtain FDA approval for new drugs or by engineering/construction firms and their clients creating rigorous quality control specifications and test programs for semiconductor or biotech facilities. Building temples in the Nile Valley during the time of the pharaohs or the interstate highway system and large flood control, irrigation and hydroelectric dams in the USA during the 1950s through 1970s satisfied many of the above conditions relatively well. However, it is difficult to argue that a comparable level of stability and predictability of economic and political conditions prevails today in Egypt or North America for, say, construction of large-scale hydroelectric projects on the Nile or stem cell research facilities in California, respectively. For projects situated in the extremely dynamic political economies and global markets of the twenty-first century, the rigour, detailed work breakdown and inflexibility that are intrinsic to the 'PM 1.0' PMBOK philosophy of detailed, centralized planning and control of large, lengthy projects have proven to be excessively burdensome and unresponsive.

PM 1.0 is not agile

PM 1.0 is not optimized for interoperability or agility (Alberts and Hayes, 2003). When managers have designed and planned projects in detail, not only do they believe that they have a good plan for execution, but they also typically believe that they have the basis to solicit competitive fixed-price bids from a large supply chain of specialized contractors and vendors for supplying and installing the components of the project. Competitive lump-sum bidding for specialized work is not necessarily recommended or prescribed by PM 1.0, but it has historically often been used in mature markets where mature and fragmented supply chains make it possible to do this. The competition engendered by competitive bidding for fixed-price contracts can drive down suppliers' margins to the benefit of the project sponsors, provided that the bid price ends up being the same as—or at least close to—the final price.

However, Lawrence and Lorsch (1967) pointed out almost 50 years ago that when a task becomes fragmented and subtasks are carried out by specialists, goal misalignment begins to appear because of the different

perspectives of the various specialists and that progressively more inconsistent and conflicting subgoals evolve within each specialist group over time. This is the inherent organizational trade-off between the economies and efficiencies of specialization *vs.* the attendant increasing difficulties and costs of coordinating the fragmented teams of specialists. The challenge of resolving these specialists' inconsistent subgoals in specialized, and often outsourced, project sub-teams has never been adequately addressed in the PM 1.0 framework.

As a result, the effectiveness of centralized planning and control on projects involving multiple parties that were retained through competitively bid fixed-price contracts, and which thus have only partially aligned goals, erodes and ultimately collapses when faced with very dynamic project environments. Contractors on competitively bid fixed-price contracts typically have margins that are too thin for them to absorb any significant changes that occur over the life of a project. So, interdependencies between specialist departments and specialized subcontractors that were not foreseen, or that were foreseen but were not adequately coordinated, give rise to technical problems at contract interfaces. The attendant delays and cost increases generate conflicts and can result in substantial transaction costs through claims, change orders and litigation before the project is ultimately closed out. The Trans-Alaska Oil Pipeline, the Chunnel Project, Boston's Big Dig and many defence programs over the last several decades that were delivered in this way ended up overrunning their budgets and schedules by many times, caused, in large part, by changes in project scope or key project assumptions. The direct costs of these changes were then exacerbated by the significant additional transaction costs that arose to resolve countervailing claims in the presence of a PM 1.0 project management philosophy (Miller and Lessard, 2000; Flyvbjerg *et al.*, 2003). As Professor John Fondahl, inventor of the precedence diagramming critical path method (CPM), sadly recounted in his ASCE Peurifoy Award address in 1990, claims consultants and their expert witnesses have become the most sophisticated users of CPM.

PM 1.0 does not engage all available knowledge

Since planning, and replanning in response to variances in project status, is done centrally under PM 1.0, the expertise of a distributed team of specialists and subcontractors cannot easily be tapped to develop globally optimal solutions to local problems. The millennial generation is accustomed to having a say in all aspects of their world, and members of this generation who are currently entering the workforce do not easily fit into the 'worker bee ranks' of a PM 1.0 organization. On the one hand, the organization is losing the knowledge and perspectives that a distributed team could bring to resolving project problems; on the other hand, the educated and talented knowledge workers who are excluded from substantive decision-making about the project they are working on become demotivated and, in the view of this author, will increasingly choose to exit from PM 1.0-style project organizations for this reason.

PM 1.0 is viewed as operational: not as strategic

PM 1.0 has been relatively unknown and unwanted in the executive suite. Executives—with a few notable exceptions—have typically considered the details of project management to be 'below their pay grade' and have viewed developing strategy as 'above the pay grade' of project implementers. An editor at the Harvard business review told the author in 2002 that '*We publish for executives. We don't do project management!*'. This breakdown in communications between strategy makers and strategy implementers is one reason that many well-formulated strategies are ultimately not successfully implemented. But project management, appropriately adapted to ensure a two-way communication between strategy makers and strategy implementers, can be used as a language to drive successful execution of even the most challenging corporate strategies as Morgan *et al.* (2007) pointed out.

Different times require more agile PM processes

As the discussion above makes clear, the level of turbulence in today's technologies, markets and geopolitics requires more agile project management processes. At the same time, a new generation of knowledge workers have experienced a level of technology-enabled democracy that makes them reluctant to work in command-and-control-style organizations of any kind, including PM 1.0 organizations. We discuss these two drivers of PM 2.0 in this section.

Dynamic project contexts require more agility

The economic turbulence and political turbulence that have unfolded in the first decade of the twenty-first century will undoubtedly continue to be exacerbated by climate change, as sea levels rise and weather becomes harsher. Global outsourcing of many kinds of manufacturing and knowledge works is creating long, complex supply chains that are highly vulnerable to political, economic and natural hazards. This can be witnessed in the worldwide effect of the 2011 earthquake

and tsunami in northeast Japan on the manufacturing of everything from iPads to automobiles in the USA and Europe. Moreover, the weakness of OECD national economies such as Ireland, Greece, Portugal and others in 2011 following the economic meltdown of 2008–2009, combined with the rising economic clout of the resource-rich developing countries, further complicates and roils global trade and commerce, leading to rising commodity prices, inflation and currency fluctuations. In a world this turbulent, the scope of a project of any significant scope and scale cannot be considered to be fixed and locked into a baseline plan for its duration. Customers' strategic needs and desires and the achievement of project outcomes are going to be subjected to significant uncertainty and change. This has already overwhelmed the PM 1.0 project management philosophy in many cases and will continue to do so.

Project planning and execution processes for this dynamic context must be extremely agile. That is, they must be flexible to accommodate changes in scope, schedule and resources in real time, rather than regarding these as determined by a fixed baseline plan from which variances must be minimized. Product releases should occur frequently so that the scope of features included in a particular product release can be varied without causing catastrophic sales and revenue impacts for the producers. If product releases occur frequently enough, features that were not included in a current release will soon be available in the next release. And talented knowledge workers will feel that they have the authority and the charter to make changes in project outputs in order to achieve a more optimal trade-off among high-level strategic outcomes that they understand without escalating these requests through a chain of command. As we will discuss, many of these elements of agility are incorporated in some of the emerging PM 2.0 approaches for planning and executing projects.

Web 2.0 workers insist on more autonomy

Today's always-on, connected and tech-savvy knowledge workers expect to have a significant say about all aspects of their lives. They have grown up not just in the Internet age, but in the Web 2.0 Internet age. Many writers have argued that Web 1.0 essentially substituted the Internet for printing presses, radio broadcasting stations and other sources of centralized media content. In contrast, as shown in Table 1, Web 2.0 is a radical departure from traditional media production and distribution, as well as the first generation of Internet applications, often called Web 1.0. In Web 2.0, anyone with a personal computer or smart phone—not professional writers, music producers or filmmakers—produces and distributes media content in real time. Moreover, this content is not screened by editors before publishing; rather it is evaluated by the universe of other media producers and consumers who vote for the content they like by clicking on it (see Table 1).

Table 1 Characteristics of Web 1.0 *vs.* Web 2.0

	Web 1.0—1990s (similar to traditional media)	Web 2.0—2000s
Who produces 'content'?	Professionals produce content	Anyone and everyone produces content
Who screens and edits content?	Editors screen and edit content	Community votes, scores, ranks and reviews content explicitly or just by clicking on interesting media
How is content distributed?	Broadcast, one to many	Share, many to many
When is content distributed?	Scheduled, periodic	Unscheduled, continuous, real time

The most frequently watched YouTube videos move to the top of the stack. All kinds of service providers are rated not by the gourmet editors of the Michelin restaurant guide or professional product testers at Consumer Reports, but rather by the vast community of other producers and consumers of user ratings on websites such as Yelp. Even traditional manufacturers such as Procter & Gamble are 'crowd sourcing' new product development ideas over the Internet. Political rallies are organized and redirected in real time via instant messaging or 'Tweeting' on cell phones and so on.

Just as young people in the Arab Spring of 2011 who had been exposed to this kind of technology-enabled social democracy rebelled against political autocracy, young workers around the world rebel against traditional management and project management approaches that rely on centralized planning and control and broadcast-style communication of goals and requirements to them.

Essence of PM 2.0

In their excellent treatise on next-generation, radically decentralized management of highly trained soldiers engaged in fast-moving 'asymmetric warfare', Alberts and Hayes (2003) laid out the two key requirements for agile organizations: *shared global awareness* and *self-synchronization*.

Achieve shared global awareness at the edge

Alberts and Hayes asserted that implementers of programs and projects need to be able to exchange rich and meaningful information flexibly directly with each other in real time to make sense of a fast-changing, complex situation—for example, special forces fighting asymmetric warfare against elusive and fast-moving adversaries should be able to communicate easily with one another via secure networks to give each member of the team this kind of shared global awareness. While free and open, many-to-many communication may be desirable in principle to create global awareness, it has been infeasible in practice for everyone to communicate with everyone about everything in any organization beyond the scale of a startup in a garage. This overwhelms everyone with too much information—hence the emergence of hierarchies that reduce the amount of information communicated to and from each person in almost every kind of organizational structure that has been evolved to date. Matrix organizations attempt to use multiple hierarchies and distinguish the kinds of information that flows through each one—project or program managers communicate about what and when; functional managers communicate through a separate hierarchy about how. Even the multidimensional matrix structures of the kind used at IBM channel information flow through multiple hierarchies so that everyone does not need to communicate with everyone else.

What has changed recently is the availability of increasingly effective 'publish and subscribe' and related protocols that reduce information overload by filtering incoming communications 'published' globally by others according to the criteria that each worker sets in her or his 'subscribe' profile. Many of us are already engaged in 'publish and subscribe' communication through setting up e-mail filtering, automatic downloading of selected newsfeeds and choosing to be—or not to be—Facebook friends, LinkedIn group members, Twitter followers and so on. As the tools for intelligent filtering get smarter, the justification for hierarchy to reduce information overload becomes less compelling, and its weaknesses, including the introduction of delay and bias in upward and downward communications, become more salient.

Self-synchronization actions

Shared global awareness at the edge of the organization and the delegation of authority to well-trained and well-motivated workers allow workers to combine and recombine their resources autonomously on demand to ensure rapid, coherent responses that utilize all of the resources available to the enterprise. A special force soldier has this kind of global awareness through wireless communication of text or video information to his heads-up display and can instantly decide to render assistance to one of his colleagues in need of assistance that he can provide. Similarly, as we will see below, members of a 'scrum team' engaged in software development can offer their skills and energy to one another autonomously as needed.

Transitioning from PM1.0 to PM 2.0: 'lean production concepts'

There is a continuum from top-down, detailed-target-driven PM 1.0 to a variety of relatively more decentralized forms of project management, culminating in PM 2.0 approaches such as Salesforce's agile development method (ADM), described next. The steady introduction and dissemination of lean management concepts can help organizations launch a gradual transition from top-down target-driven PM 1.0 to a more decentralized, customer-value-driven form of PM 2.0. Lean production methods developed for manufacturing have been adapted for project-oriented industries such as construction by several researchers including Ballard (2008). Lean production methods seek to maximize value for the client and minimize wasted time and effort in achieving desired client outcomes. Lean project management methods generally focus on having the client drive decision-making on a project by continually communicating its desired high-level project values and outcomes—and, more importantly, any changes in desired outcomes or trade-offs among them that arise over the course of the project. The project team responds to stated client values and desired outcomes using a set of decision-making methods that include *Value Driven Design, Pull Scheduling, Last Responsible Moment* and *Reliable Promises.* These approaches will be discussed in more detail in Ballard and Tommelein (forthcoming).

Examples of PM 2.0

We next look at some emerging examples of PM 2.0 in practice: *Scrum* approaches that are increasingly being used for software development, the *US Military's Power to the Edge* concepts and *Lean Construction* methods that are now being used for construction of some complex facilities such as airports and hospitals.

Salesforce.com's ADM

Salesforce.com, founded in 1999 to build a new market in subscription-based business software services, had experienced annual growth rates of 30–40% in both customer usage and head count. By 2006, the existing

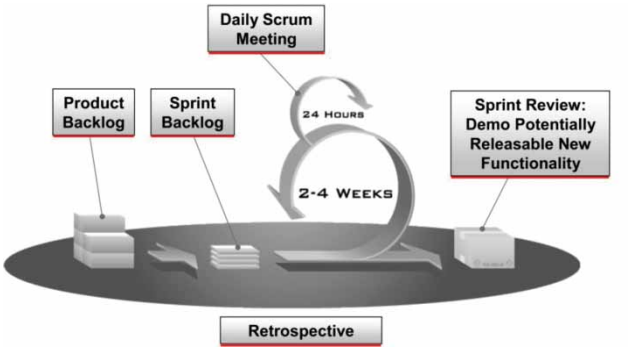

Figure 1 Scrum lifecycle (source: Salesforce.com company documents).

development processes had been slipping for some time. The pace of releases of new software features—a key measure of value for customers—had slowed from four times per year to once per year, and the latest release was taking even longer than that. Morale was suffering across the organization, a highly respected senior developer had recently quit after delivering a scathing offsite presentation that criticized nearly everything about the current situation and an infrastructure failure had caused service outages that prevented customers from accessing their customer information during the critical pre-holiday period in 2005 and again in early 2006, further eroding users' trust in the reliability of Salesforce.com's 'software in the cloud' service capabilities. Parker Harris, one of four Salesforce.com founders and currently EVP—Technology and Products—had listened to his senior program managers' description of 'agile' or 'scrum' development processes compared with the traditional 'waterfall' approach, asked a lot of questions and then instructed them to implement the new method throughout the R&D organization. 'We need real change', he said. 'Let's skip the pilot and go for the big bang. Our system is broken, and we don't have time to wait—so let's go ahead and fix it all at once' (Levitt *et al.*, 2009). This was a tremendous organizational change challenge for the two managers, Chris Fry and Steve Greene, who had been tasked to lead the change to agile methods. The company had been using a traditional PM 1.0 waterfall style of project management development. After studying various agile and 'extreme' software development methodologies, Fry and Greene came up with a variant of the scrum methodology, which they called the ADM. The way in which ADM would ultimately be implemented at Salesforce.com is illustrated in Figure 1 and involved the following characteristics:

- The 300-person development group—now approaching 1000 and still using this approach—was broken down into multiple cross-functional sprint teams, each containing no more than 10 people. The team would include several programmers plus a QA/testing person, a product/marketing representative, user interaction specialist and a localization person.
- The set of desired features for the next release is expressed as a *Product Backlog* defined in terms of 'user stories', each describing a particular function or task that the user wished to accomplish, but not specifying how it is to be implemented in the code. The team is expected to derive its own specifications for each user story.
- Team members estimate the work volume for items in the Sprint Backlog approximately—for example, by using one of the Fibonacci numbers to indicate the rough magnitude of each user story. They then limit the total number of user stories in the backlog to those they believe the team can accomplish during the sprint duration. Note that this is very similar to the Kanban approach for limiting work-in-process used by companies such as Toyota that practise lean manufacturing.
- Planning and replanning are carried out in daily morning 'stand-up meeting' no longer than 15 min, at which team members would discuss status, identify any obstacles to their progress and expect the ScrumMaster—their project manager, now playing the role of a facilitator—to unblock for them.
- Automated test suites for each module of code are developed by QA team members and coders as the code progresses, rather than relying on external validation and testing.
- Weekly builds of the modules are carried out each week to detect integration problems and fix them early. Anyone who writes code that 'breaks the build' is sorely embarrassed by the requirement to wear a T-shirt stating 'I broke the build!' for the next week. This illustrates a key difference in authority structures. Workers are motivated more by their social status and reputation in their team than by any monitoring with attendant rewards or sanctions administered through the hierarchy.
- Each scrum team must demo its completed user stories to other scrum teams and company management at the end of the scrum.
- If a particular user story cannot be fully 'done'—that is, coded, tested, optimized for user interaction and localized—before the end of the scrum, the team involved has the authority to remove that user story from the release and postpone its completion to the next release. This delegation of scope control down to the sub-team level is a unique feature of Salesforce.com's approach to

scrum. This works for them because the next release comes so soon that it is not a major catastrophe to delay a feature by one release; it is a much larger catastrophe to release code that is not going to work properly and might cause a system outage as had happened in 2005 and 2006, preventing all of Salesforce's customers from using the system. However, this level of flexibility and decentralization of decisions about scope is obviously not feasible for all kinds of projects.[2]

Agile transition to the ADM at Salesforce.com

When asked to assist in this change to PM 2.0 at Salesforce, even the most ardent enthusiasts of scrum methodology—including Schwaber—suggested doing a small pilot first and balked at the idea of an across-the-board rollout of this approach for an entire development team at once. Chris Fry and Steve Greene, the managers tasked with implementing Scrum across the board, believed firmly in these agile management principles and decided to go ahead anyway. In designing the approach to carry out this very challenging organizational change project, they 'ate their own dog food!'. To roll out the ADM for the entire development team at Salesforce, they developed an agile method of implementing the organizational change, using multiple decentralized teams, training workers and first-line managers in the ADM and decentralizing control for a change effort to these teams. Their remarkably successful agile rollout of the agile software development method is described further in detail in Levitt *et al.* (2009).

PM 2.0 in the military: 'Power to the Edge'

Alberts and Hayes' (2003) doctrine for an agile US military to 'wage asymmetric warfare in difficult times' has been briefly described above. In this approach, a small group of senior commanders and headquarters clearly specifies and publishes its high-level goals and objectives—its 'command intent'. Headquarters set up a 'publish and subscribe'-networked broadband IT architecture so that all units at the edge can share rich information freely and securely. Through this publish and subscribe network, the highly trained units and individuals 'at the edge' can gain a high level of 'shared global awareness' by viewing each others' information without becoming overwhelmed by information overload. Units then 'self-synchronize' to assist each other as needed and adjust their tactics autonomously based on their shared awareness of a rapidly evolving situation, while keeping in mind the command intent communicated to them by headquarters.

In the fast-changing and unpredictable environment in which a special operations team like the one sent out to capture or kill Osama bin Laden operates, there is simply no time to wait for minute-by-minute orders from a distant HQ! This can be contrasted with World War II films showing Winston Churchill and his senior commanders in a control centre underneath 10 Downing St. receiving wireless communications from multiple ships, submarines and airplanes, moving models of Allied and Axis ships and airplanes around on a map of the North Atlantic Ocean, North Sea and English Channel, and then radioing orders to each of the captains and commanders about what they should do next.

IPD of buildings and infrastructure

The author is not aware of a full-blown PM 2.0 implementation of project management in the construction industry as of mid-2011. However, several recent projects are using new forms of contracts and lean management principles that have a great deal in common with the 'Power to the Edge' and 'ADM' PM 2.0 philosophies described in the previous two examples.

Following the UK government-commissioned Latham Report (Latham 1994) on ways to make the construction industry more effective in the UK, British Airports Authority (BAA) decided to use a radically different approach for the construction of Terminal Five at Heathrow airport for British Airways:

- First, they deployed a form of contracting that has become known as integrated project delivery (IPD). IPD abandons the idea of developing detailed designs and specifications and then putting them out to competitive bid. A client assembles a team of designers and builders to work jointly with it starting from the conceptual design phase and all the way through construction into operations. This team is selected based on qualifications and then retained on a reimbursable price basis. Each member of the team will share in an overall incentive pool based on the extent to which the final project meets the client's objectives—its 'command intent'. Clearly, this kind of contractual structure creates a set of motivations that is completely different from a fully designed 'good plan' that is put out to competitive bid by multiple specialists who are trying to sub-optimize their own efficiency and cost.
- Second, the team members are assembled in a shared workspace in which they can easily

[2]The 'scrum' agile software development methodology, popularized by Kenneth Schwaber, is a classic PM 2.0 process and is described more fully in Schwaber and Beedle (2001); Salesforce.com's ADM adaptation of scrum is described more fully in Levitt *et al.* (2009).

collaborate to develop integrated and globally optimal solutions, especially for highly interdependent components such as mechanical electrical and plumbing systems.
- Third, many of the lean production methods listed above are typically used in an IPD project.

The IPD–lean project management approach used for Terminal Five was able to respond to substantial changes in the design of the airport to accommodate Airbus Industries' new and much larger A380 airplane that was announced midway through this project and to achieve overall performance that met the majority of the client's key objectives.[3]

Early results of these IPD project delivery approaches for complex facilities such as airports and hospitals have been very encouraging. A similar IPD–lean project management approach has been adopted by Sutter Health in the Western United States to build a number of new hospitals. The Sutter Health Camino Medical Center used a form of IPD contract for the key engineering and construction trades, a shared workspace for the mechanical electrical and plumbing designers and construction managers, a shared Building Information Model to facilitate integrating and checking the cross-disciplinary design interfaces for possible interferences and many lean manufacturing techniques. This project met key project milestones for delivery and experienced virtually no rework during construction (Khanzode 2011).

These clients and a growing number of others believe that the increased overall project value that they can derive from this more integrated and less adversarial process is significantly larger than any lost savings in construction prices from a less competitive bidding process. They are thus willing to forgo the dubious cost savings from a more competitively bid construction project, since they believe that they will ultimately have to pay the full cost of construction through change orders anyway, and the near-zero transaction costs associated with the IPD form of project delivery are substantially lower than the transaction costs from post-award change order negotiations, claims, arbitration and litigation that have typically been associated with traditional PM 1.0 project management with design–bid–build project delivery on large, complex projects such as international airports and full-service hospitals (Khanzode 2011). For government clients, moving towards PM 2.0 will require that they become comfortable with this trade-off and believe that it is attractive when applied to their projects. Facility managers will then need to drive this new philosophy to the organization, including everyone from their boards of directors to their procurement staff.

Tools, training and HR practices to support PM 2.0

We have not studied tools, training and HR practices used in PM 2.0 projects systematically, but our case studies to date have found some relatively consistent practices for PM 2.0 projects.

Tools for PM 2.0

In the spirit of lean management, the planning and replanning tools used for some of these very decentralized forms of PM 2.0 are very simple. For the first two years of their operation, Salesforce.com's scrum teams used just hand-sketched 'Burndown Charts', other simple diagrams and coloured post-it notes laid out on whiteboards. When they began working with team members in other locations, browser-based tools that emulated these simple tools were developed and shared among scrum team members. Some were as simple as a webcam pointing at a whiteboard plastered with post-it notes. Since the scrum master is responsible for unblocking obstacles to the progress of team members' work, some kind of issue-tracking system is needed to keep track of obstacles and their resolution. Many of the current project extranet portals have similar issue-tracking tools, often with embedded workflow so that everyone can see when and where issue resolution is getting bogged down.

Training in scrum or similar agile management techniques

Any radical shift from past practices requires extensive training. Chris Fry and Steve Greene at Salesforce.com insisted that all of the key members of their development team received training in scrum methods. Employees new to the company who had not worked in this style before received training before being assigned to scrum teams. The same was true for the lean management tools used at Heathrow Terminal Five and in the Sutter Health hospital projects.

HR practices for PM 2.0

PM 2.0 offers many advantages for some kinds of projects. At the same time, it requires a different approach towards hiring, nurturing and retaining employees.

[3]For additional details on the IPD approach used at Heathrow Terminal Five, see Gil (2009). For a broader discussion of the need for relational contracting in global infrastructure projects, see Henisz and Levitt (2012).

Characteristics of Web 2.0 workers

The managers at Salesforce.com insisted that they could only use their ADM with employees who possessed the following:

> High levels of knowledge and experience: The teams of specialists are grouped and co-located by software module, instead of by discipline, so there is no large group of specialists from each function (e.g. coding, quality assurance and testing) who are easily available to mentor and supervise specialists who run into technical challenges. Workers must be able to make good decisions about how to implement, test and deliver the code that enables each of the user stories with effectively zero supervision.
>
> Team players with internal motivation: Workers in each of the scrum teams execute their tasks with essentially no monitoring or supervision from technical supervisors, so they must have a high level of internal motivation. They are motivated by their level of status and respect in their peer community —their scrum team—rather than by their salary, formal title or position in the hierarchy. Thus, they are accountable for their performance to their fellow team members, not to anyone in the hierarchy. This trait of being evaluated by one's team members rather than by a supervisor in a hierarchy fits perfectly with the Web 2.0 characteristics of today's knowledge workers described above.
>
> High tolerance for ambiguity: Working in this kind of environment, with very few rules or procedures about how to do things, requires workers to have a high tolerance for ambiguity. There is no right way to do things except the way that they choose to do them. They will be evaluated by their team members and sanctioned socially. Of course, team members who consistently fail to achieve consensually agreed-upon standards of productivity and helpfulness to fellow team members will be socially ostracized by the team and will eventually be evicted from the company.

Web 2.0 hiring practices

As explained above, PM 2.0 organizations need 'A Team' players who can also work in teams and have a high tolerance for ambiguity. Technical specialists who will work in a PM 2.0 environment must be rigorously screened for technical excellence and prior experience, but hired only after a process of extended multiple interviews with people from all of the key disciplines with whom they are likely to interact. The interviews should be designed to assess a prospective new hire's temperament and skills for teamwork in a very unstructured environment *vs.* to assess his or her capacity for individual accomplishment that might be indicated by grades or prior technical performance evaluations. Some companies include bringing potential hires into social activities such as Friday afternoon happy hours as part of the hiring process.

Limits of PM 2.0

There are clearly some questions about the scalability of PM 2.0 that will need further research. These are discussed briefly in this section.

Need for 'A Team' players?

If only a few companies in the industry practise PM 2.0, they can continually recruit disaffected 'A Team' players away from traditional firms. As this approach grows in popularity, PM 2.0 firms will begin to steal each other's employees with no net growth in the population of 'A Team' players. This kind of beggar-thy-neighbour recruiting took off in India during the early 2000s when demand for software outsourcing grew rapidly and companies faced a shortage of skilled programmers, leading to turnover rates above 300% per annum, and rapidly escalating salaries for employees who were receiving successive 'northeast–northwest' promotions each time they moved out of and back into the company. There is some evidence that this is now also beginning to happen for skilled factory workers in China as the number of rural migrants to cities is declining. 'A Team' players need to start out as inexperienced programmers, quality control engineers, etc. and must get that early experience somewhere. If a PM 2.0 approach is to become more widespread, firms will need to evolve new methods to develop and utilize less experienced 'A Team' players and significant numbers of 'B Team' players in their PM 2.0 organizations.

Using PM 2.0 with remote participants?

Salesforce.com has been able to work with remote participants located 500 miles away in the same state and time zone. But how well might this approach work in scrum teams that are distributed more widely across time zones, languages and national institutions? Synchronous coordination methods such as daily 15 min stand-up meetings are obviously difficult to conduct remotely, especially across large time zone gaps such as USA–India. Even more importantly, PM 2.0 is a management approach that requires the development

of high levels of trust between team members. This is traditionally enabled by face-to-face social exchange—the ongoing reciprocal exchange of small favours for obligations, as described by Homans (1958). Social networking tools have begun to enable meaningful social exchange to occur between remote participants, so they can exchange online favours for obligations and develop some level of trust with one another without the need for face-to-face contact. However, there is no evidence yet that high enough levels of interpersonal trust can be developed remotely to sustain intense PM 2.0 projects in groups such as scrum teams without a high degree of co-location.

High risk, regulated projects?

One of the key attributes of PM 2.0 is the ability to allow project resources, schedule and even scope to be changed by project team members, based on their understanding of the client's high-level values and outcome preferences. But what if the project scope needs to be rigorously controlled to avoid risk to the public from nuclear meltdowns, chemical plant explosions, contaminated food or drugs and the like? Projects such as these require rigorous, top-down control of specification and testing to protect public safety and health. On projects such as these, it is difficult to see how senior managers could permit uncontrolled scope changes and decentralized development of test routines. Such projects are likely to remain the province of PM 1.0.

Towards a contingent design of PM processes

Classical management authors in the early part of the twentieth century like Fayol (1949/1916) were practitioners who proposed a uniform set of organizational principles, such as *unity of command*, which all organization should follow. Starting in the 1960s and 1970s, a more nuanced view of organizational design emerged. The 'Contingency' theory of organization design suggested that there was no single developed best organization; rather, different organizations would perform better or worse in different contexts. The most comprehensive contingent organization design framework to date was presented by Burton and Obel (2004). Not only did this book provide a rich and rigorous set of contingent design guidelines for a range of environmental, technological, demographic and management style variables, but it also included a disk with an 'expert system' software application called 'OrgCon' that could guide an organization design consultation.

There has been much less research devoted to contingent design of project organizations. The PMBOK suggests a single, hierarchical, top-down style of planning and control structure for project organizations.

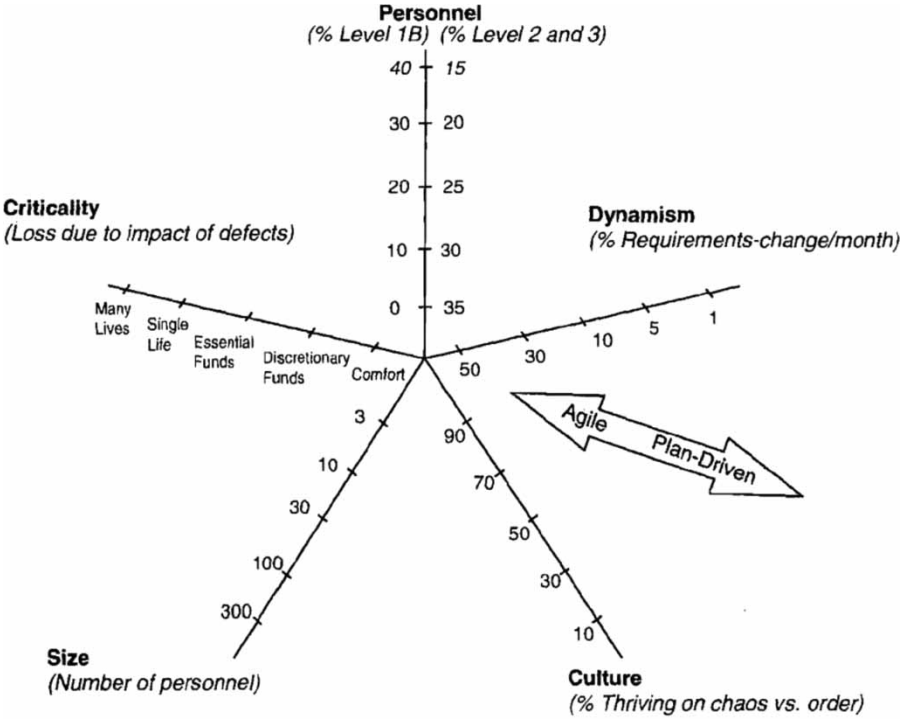

Figure 2 Contingent design of project management processes (source: Boehm and Turner, 2004)

One of the first authors to suggest a contingent approach for the design of project organizations was Shenhar (2001). He proposed a two-dimensional scale, with four levels of technological uncertainty and three levels of scope/system complexity, to categorize projects and suggested ways in which projects could be organized contingently. He proposed that as technical uncertainty increases, project development should use iterative prototyping rather than a single fixed design and require more attention to trade-offs among variables. Furthermore, as the scope and complexity of projects, which he termed 'system complexity' increase, the project should be managed with more rigorous, PM 1.0-style, top-down planning and control. Henisz and Levitt (2012) explored the conditions under which large infrastructure projects should be managed in a PM 1.0 style, using conventional arms-length contracting with specialists selected for each project via competitive bidding, *vs.* in a PM 2.0 style via 'relational contracting' that exploits psychological and sociological mechanisms—for example, developing a shared identity for all project stakeholders and facilitating social exchange among key participants across multiple projects—to encourage cooperative behaviour in this intrinsically fragmented and decentralized project context.

Boehm and Turner (2004) have developed a comprehensive set of guidelines for contingent design of PM 1.0 *vs.* PM 2.0 organizations and work processes for software development. They proposed five variables for large software projects that indicate the use of a conventional PM 1.0-style waterfall project management approach *vs.* a PM 2.0-style scrum or other agile approach (see Figure 2). Their dimensions include the skill level of project personnel; the 'dynamism' or frequency with which project requirements are likely to change; the organizational culture (thriving on chaos *vs.* order); the team size and the criticality in terms of the potential negative impacts of defects.

Given the increased rate of change of technologies, markets and political and economic contexts facing today's projects and the expectations of the Web 2.0 workforce for autonomy and participation in decision-making, project managers will face increasing demands to move towards PM 2.0-style project organizations and lean management techniques. However, some projects will still require aspects of the rigour of PM 1.0 to ensure systematic integration of complex technical systems and to protect public health and safety.

As Shenhar (2001) suggested, there is a clear need to develop (1) a richer ontology for describing project organizations and work methods and (2) frameworks and tools to configure these elements contingently into project organizations that will best meet the demands of the full gamut of twenty-first-century projects. The early research on contingent project organization design discussed in this section provides some valuable stepping stones towards developing a contingent framework for designing project organizations. This body of research must now be integrated, extended, generalized and tested for a range of different kinds of projects to develop a contingent theory of project organizations in the spirit of Burton and Obel's (2003) comprehensive contingency framework for enterprise organization design.

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