# Can We Manage Agile in Traditional Project Environments?

Hans J. Thamhain
Bentley University, Waltham, Massachusetts - USA

***Abstract*-- *Agile* has gained much *attention and controversy* as a contemporary project management approach. While many management practitioners and researcher, report great benefits and advantages over traditional execution methods, others experienced disappointments or outright failures with this contemporary process which differs from established principles and standards of conventional project management.-- This paper reports the results of a three-year field study into the practices of *Agile* project management at 37 technology-intensive companies. It shows that the *principles* of this contemporary technique are applicable to most projects independent of their nature, size or IT-orientation, improving resource effectiveness, project execution time and overall project success. However, the study also shows that for large and highly complex projects, and for most situations outside of software and IT, the *Agile* methodology must be carefully modified to fit the organizational processes and cultures of the enterprise.**

## I. INTRODUCTION

Virtually every organization in our fiercely competitive business environment is under pressure to do more things faster, better and cheaper, and project management has become an important toolset for implementation time- and resource-constraint missions. Whether we want to roll out a new product, build a new power plant, create a new movie, or win a presidential election campaign, project management provides the tools for effective implementation and for potentially wringing out competitive advantages and strategic benefits.-- Among the many contemporary project management approaches that evolved in recent years, *Agile* has gained much *attention and controversy* among management practitioners and researcher [6, 8, 30]. While proponents of *Agile* report many benefits and advantages over traditional project execution methods, especially in the IT area, others experienced disappointments or outright failures with this contemporary process which differs from established principles and standards of conventional project management. Many of the problems focus on the context of *Agile* applications outside of IT and the validity of the process especially to large and highly complex projects.

Before we can discuss the benefits and challenges of Agile and the relevancy to specific types of projects, we need to define the concept and its differences to more conventional project execution methods. However, with its own terminology, methods and management philosophy, even a simple definition can get very complicated. Therefore we often find thumbnail descriptions of Agile in the literature that provide a useful top-down perspective, such as the *short Wikipedia definition* adopted for this paper:

> *Agile management is the execution of projects in a highly flexible and interactive manner, in opposite to the waterfall method.*

Many of the top-down definitions focus on the interactive, flexible execution as the key feature of Agile. It is this characteristic that got the attention of the greater project community right from the start when Agile emerged in the early 2000's. The guiding philosophy of Agile is that the project team works as a complex, adaptive system.

### *How did Agile Project Management Philosophy Emerge?*

Up to the 1980s the *waterfall model* was the prevailing method for project execution. For example, the U.S. Department of Defense was actively promoting the use of this method for many decades, reinforced by various policies and directives such as DOD Standard MIL-STD-498, cancelled in 1998, but still in use as a guideline for many projects today. Waterfall is defined as the sequential execution of projects with clearly defined deliverables for each stage. Audits are often built into the process to ensure that specific results have been delivered before the project continues to its next phase. These traditional lifecycle concepts established the organizational framework for many of the project-oriented management systems in use today, providing a platform for delivering mission-specific results. Yet, starting already with the 1980s, the dramatic changes in the business environment required the process of project management to be reengineered to deal effectively with new challenges [13, 31, 38, 43] and to balance efficiency, speed, and quality [1]. As our business environment became more competitive, virtually every organization tried to fine-tune their existing project management process toward faster, better, and cheaper deliveries. New technologies, especially in computers and communications, removed many of the protective barriers to business, creating enormous opportunities and challenges, and transformed our global economy into a hypercompetitive enterprise system. To survive and prosper, in this new environment project leaders had to deal effectively with time-to-market pressures, innovation, cost, and risks in an increasingly fast-changing global business environment [27]. More iterative, incremental project management gained momentum in the 1990s and becoming the norm for developing and introducing new products, systems, and services [14, 23], gradually replacing the traditional waterfall model. These iterative/incremental methods also formed the basis for a wide spectrum of contemporary management systems, ranging from *Concurrent Engineering* to *Stage-Gate®* [10], and starting in 2001to include *Agile* plus its derivatives, such as *Extreme, Lean and Guerilla Project Management*. These iterative approaches are also known as *iterative lifecycle* or *adaptive project life cycle* or *change-*

*driven methods*, intended to facilitate change and require a high degree of ongoing stakeholder involvement.

The focus that all of these iterative applications have in common is the effective, integrated, and often concurrent multidisciplinary project team effort toward specific deliverables which is the very essence of what we define today as *Agile*.

**The History of Agile**

In February 2001, 17 software professionals met at The Lodge at Snowbird, a ski resort in the Wasatch mountains of Utah to discuss more effective alternatives to current software development methods [12]. This group of independent thinkers included representatives of many unconventional management methods such as Extreme Programming, SCRUM, Adaptive Software Development, Crystal, Dynamic Systems Development Method (DSDM), Feature-Driven Development and Pragmatic Programming. What emerged from this meeting was the *Manifesto for Agile Software Development* which reads:

---

"We are uncovering better ways of developing software by doing it and helping others do it. Through this work we have come to value:

- Individuals and interactions over processes and tools
- Working software over comprehensive documentation
- Customer collaboration over contract negotiation
- Responding to change over following a plan

That is, while there is value in the items on the right, we value the items on the left more.

[Kent Beck, Mike Beedle, Arie van Bennekum, Alistair Cockburn, Ward Cunningham, Martin Fowler, James Grenning, Jim Highsmith, Andrew Hunt, Ron Jeffries, Jon Kern, Robert C. Martin, Steve Mellor, Ken Schwaber, Jeff Sutherland, Dave Thomas, Brian Marick].

---

The Agile Manifesto is based on twelve principles (Beck et al 2001) which are listed in Table 3.

In an ongoing effort to make these principles more generally applicable to product and project management in general, a group headed by Alistair Cockburn and Jim Highsmith worked on the refinement of the agile concept. In 2005, they published an *addendum* to the *Manifesto* known as the agile project management "Declaration of Interdependence" (Cockburn 2005).

Other important developments included the formation of the Scrum Alliance, led by Ken Schwaber in 2004 and the Scrum.org in 2009, creating the Certified Scrum Master programs and various other forms of agile training and certification.

Today, agile project management philosophy and principles enjoy widespread acceptance in the software development community and are gaining increasing attention of project managers across all industry and government organizations for potential application and improvement of their project operations.

Yet, regardless of the label given to the execution method, many of these contemporary management systems focus on specific project environments such as manufacturing, marketing, software development, or field services [19]. As a result, a large number of mission-specific project management platforms emerged under the umbrella of *integrated product development ( IPD) [31]*. These well-established platforms include systems such as *Design for Manufacture (DMF)*, *Just-in-Time (JIT)*, *Continuous Process Improvement (CPI)*, *Integrated Product and Process Development (IPPD)*, *Structured Systems Design (SSD)*, *Rolling Wave (RW) Concept* [20], *Phased-Developments (PD)*, *Stage-Gate® Processes* [10], *Integrated Phase-Reviews (IPR)*, and *Voice-of-the-Customer (VOC)*, just to name a few of the more popular concepts. Other contemporary project management concepts, such as *agile/scrum* [2], spiral processes [3], and *extreme project management (XPM)* [12], rely at least in part on the same concept of flexible, concurrent execution of overlapping processes.

What all of these systems have in common, regardless of their specific application focus, is the emphasis on effective cross-functional integration, and incremental, iterative implementation of project plans with emphasis on strong human interaction and collaboration [22].

### *Agile – A Unique Project Management Concept*

*Agile* is an extension of the multi-phased approach to project management which has been used across industries for a long time. While for the past three decades the concept is referred to as *concurrent engineering*, its roots go back to the era of early industrialization at the end of the 19th century[41]. As implied in its name, the concept promotes the concurrent execution of tasks segments, requiring more intense and effective interaction among overlapping task teams. This increases the need for strong cross-functional cooperation, integration and team involvement, which creates both managerial benefits and challenges [48], the operational and strategic values of concurrent engineering are much broader than just a gain in lead time and resource effectiveness; they include a wide spectrum of benefits to the enterprise, ranging from validating functionality of work-in-progress and better communication and information sharing among all stakeholders to total project lifecycle thinking and strategic alignment. These benefits are primarily derived from effective cross-functional collaboration, and full integration of the project management process with the total enterprise and its supply chain [34, 35, 36]. In this context, agile project execution evolved as an extension of concurrent engineering, providing a process template for effectively managing projects. Virtually any project can benefit from this approach. It is a systematic approach to integrated project execution that emphasizes parallel, integrated execution of project phases, replacing the traditional linear process of serial engineering and expensive design-build-rollout rework [17]. The process also requires strong attention to the human side, focusing on multidisciplinary teamwork, power sharing and team values of cooperation, trust, respect, and consensus building, engaging all stakeholders in the sharing of information and decision making, starting during the early project formation stages and continuing over the project life cycle.

### *What Are the Building Blocks?*

What are the conceptual building blocks of Agile that make its process so attractive to software developers and many other project managers in- and outside of the IT community? The fact that the agile concept was created by software developers with the objective to enhance software project management effectiveness (see text insert) points at its prime application and management focus. Yet, the

building blocks, which are defined as the "*principles of agile*," have value in many project situations, and could guide any type of project execution. Specifically, the management philosophies underlying Agile were extracted from the Agile Manifesto by the Agile Alliance [24, 25], summarized in 12 principles:

1. Customer satisfaction by rapid delivery of useful software
2. Welcome changing requirements, even late in development
3. Working software is delivered frequently
4. Working software is the principal measure of progress
5. Sustainable development, able to maintain a constant pace
6. Close, daily cooperation between business people and developers
7. Face-to-face conversation is the best form of communication (co-location)
8. Projects are built around motivated individuals, who should be trusted
9. Continuous attention to technical excellence and good design
10. Simplicity—the art of maximizing the amount of work not done—is essential
11. Facilitate self-organizing teams
12. Regular adaptation to changing circumstances

In principle, Agile offers a framework for helping teams adapting to changing environment, maintaining focus on primary project objectives, while reducing undesirable proliferation of requirements and optimizing business value. These are desirable objectives for any project. The challenge is scalability and application of these principles to specific projects, especially large undertakings and projects outside the software/IT category, an area that that is extensively debated among management practitioners and is being examined in this study.

***How Does the Process of Agile Differ from Conventional Project Management?***

Agile project management relies on the iterative, incremental project execution with the involvement and collaboration of all project stakeholder groups, such as top management, suppliers, partners, users and customers. This is also part of the conventional project management process. However, in Agile we're looking for something extra, the ability to deal with changes and uncertainty by aiming for quick, *short-term results, called releases* which are being tested in the user environment for their functionality, reliability and overall usefulness. With this Agile method a new product or service system is developed in short activity cycles, called *sprints*, creating shippable deliverables at the end of each sprint cycle. The process is summarized in Table 1 which identifies and describes the seven stages of a typical Agile project lifecycle. Another important difference to conventional project management is in the management process. Instead of relying on a project manager with traditional organizational power and project-central authority for directing the project work toward the desired results, Agile uses a *"shared power and responsibility concept"* within the project team that includes two leadership roles, the *Product Owner* and the *Scrum Master*.

*The Product Owner* is responsible for the business results, including ensuring that the project will meet its defined objectives, requirements and user satisfaction. It also includes balancing competing priorities and dealing with organizational interface issues and conflicts.

*The ScrumMaster* serves as the team's coach, facilitating coordination, collaboration and integration. Hence ensuring that team members work together in the most effective and productive way. This role also includes many of the traditional responsibilities of the project manager, such as resolving issues, tracking and reporting progress, and moving the project according to its established schedule and budget lines.

The Agile Team shares the responsibilities of managing the project, determining how to best achieve the desired results and goals. They will also collaboratively decide who should work on which tasks, and what methods, tools and techniques are most appropriate to achieve optimal results.

*Toward formal Standards*. Although no formal standards, such as ISO or PMBOK have yet been established for *Agile*, many journal articles, conference papers and books have expanded on the original *Manifesto* framework to describe how the agile process should be applied to manage in project-specific work environments [7, 9, 22, 40]. In addition, a large number of consulting companies provide professional training and certification in agile management, using their own publications and training material for describing the *agile* method and its applications. One of the more visible and recognized *Agile* certification programs is offered by the Project Management Institute, PMI, called the *Agile* Certified Practitioner (PMI-ACP). All of these documents provide a unified body of knowledge, consistent with the original framework established by the Agile Manifesto and the Scrum Alliance that is being used by managers and scholars to guide their work processes and research. It is also used in this study to benchmark and their business processes, especially for larger projects outside the IT business community [4, 33, 37]. What can we learn from these field experiences? Where and how is Agile applicable, and what are the barriers, drivers, criteria and limitations to classify project management practices at various degrees of "agile" versus "traditional."

Taken together, the objective of the Agile process is to execute projects faster, more predictable and at a lower cost. This is a very attractive promise in our fiercely competitive business environment where virtually every organization is under pressure to do more things faster, better, and cheaper. Speed has become one of the great equalizers in competitiveness and is a key performance measure. As a result, Agile has received the attention of virtually every manager and business leader. Many organizations have successfully introduced Agile into their project operations and were able to scale the process to many different types of projects,

ranging from software to hardware to system products/services. Yet, others had difficulties or experienced outright failures in adapting Agile methods to successful Agile project management? These are some of the key questions that guide this exploratory field study.

**TABLE 1**. TYPICAL STAGES OF THE AGILE PROJECT LIFECYCLE

| STAGES | ACTIVITIES AND MANAGERIAL PROCESS |
|---|---|
| **1** | The project manager (product owner in agile) identifies the *product vision: W*hat the product is, how it will be supported, how it aligns with the enterprise strategy, and who will use the product and how. |
| **2** | The project manager (product owner) creates a *product roadmap,* a high-level view of the product requirements, including prioritization and timing of requirements. |
| **3** | The project manager (product owner) creates a *release plan* which identifies a high-level timetable for the project deliverables. Agile projects have many releases. A typical release includes between three to five "sprints" with the highest priority items to be launching first. |
| **4** | The project team develops the product in short cycles (called *sprints*), creating shippable deliverables at the end of each sprint cycle. |
| **5** | Daily review meetings (called *daily scrum*) are being held to discuss what has been completed the previous day, what will be worked on today, and what issues and roadblocks need to be resolved. |
| **6** | Project cycle reviews (called *sprint reviews*) are being held at the end of each project cycle (sprint) to ensure and demonstrate to the product stakeholders that working deliverables have been created during the sprint cycle. |
| **7** | Retrospective reviews (called Sprint retrospectives) are being held at the end of each project cycle (sprint) to discusses with the project team what went well, what could be improved, and how to make these improvements happen. |

## II. METHOD

The work reported here is the continuation of my ongoing research into project management process and team leadership in complex project situations [44, 45, 46]. This paper summarizes the last three years (2010-2013) of this investigation with specific focus on Agile management practices and experiences of 35 project management teams in 17 high-technology enterprises dealing with major product developments.

The current research uses an exploratory field study format. All components of this investigation, such as the project management process, product development, team work, technology and business performance, involve highly complex sets of intricately related variables. Researchers have consistently pointed at the non-linear, often random nature of these processes, that involve many facets of the organization, its members and environment [5, 11, 28, 44, 46, 47]. Investigating these organizational processes simultaneously is not an easy task. Simple research models, such as mail surveys, are unlikely to produce significant results. Instead, one has to use exploratory methods to look beyond the obvious aspects of established theory and management practice. To work around these issues, I used the observations, discussions and interviews of my ongoing work as consultant and trainer with these 17 companies to gain insight into the work processes, management systems, decision making and organizational dynamics. This method, referred to as *action research,* includes two qualitative methods: *participant observation* and *in-depth retrospective interviewing*. It also provided access to some conventional questionnaire-based surveys. The questionnaires were personally introduced to 230 team members and 35 team leaders, yielding an overall return of 75%.

This *combined method* is particularly useful for new and exploratory investigations, such as the study reported here, which is considerably outside the framework of established theories and constructs [15, 21]. The focus on *four interrelated sets of variables: (i) risk, (ii) team, (iii) team leader and (iv) project environment.* These variables were identified in previous studies as major influences to project success [42, 43, 44, 45].

***Data.*** The unit of analysis used in this study is the project. The field study, conducted between 2010 and 2013, yielded data from 35 project teams with a total sample population of 535 professionals such as engineers, scientists, and technicians, plus their managers, including 7 supervisors, 35 project team leaders, 9 product managers, 6 directors of R&D, 5 directors of marketing, and 9 general management executives at the vice presidential level, as summarized in Table 2. Together, the data covered over 35 projects in 17 multi-national companies, of the FORTUNE-1000 category. Project team members had on average 10 years of professional experience in their field of specialty and 4 years of tenure with their current employer. For project leaders the numbers averaged 13 and 6 years, respectively. 90% of the sample population had bachelor degrees, 50% were holding masters and 15% PhDs.

**TABLE 2.** SUMMARY OF FIELD SAMPLE STATISTICS

| Project Environment | Metrics |
|---|---|
| Total sample population | 535 |
| Companies | 17 |
| Product development projects | 35 |
| Project teams | 35 |
| Project team members | 489 |
| Product managers | 9 |
| R&D managers | 6 |
| Senior managers & directors | 21 |
| Average project budget | $4.6M |
| Average project life cycle | 18 months |

The projects observed in this study involved mostly high-technology product/service-oriented developments and roll-outs, such as information system, financial services, automotive, airplane, computer and pharmaceutical products. Project budgets averaged $4.6M and project lifecycles of 18 months. All project teams saw themselves working in a high-technology, multi-national, culturally diverse environment. For the purpose of this study we distinguished among three project sizes: (i) small and medium-sized projects with 50 team members or less, (ii) large projects with over 50 team members, and (iii) mega projects with over 1000 team members. The data were obtained from three sources, *questionnaires, participant observation* and *in-*

*depth retrospective interviewing*, as discussed in the previous section. Specifically the information obtained during *retrospective interviewing* with the team leaders, line managers, product managers, marketing directors and general management executives was useful in gleaning additional, deeper insight into the processes, challenges and best practices of using Agile management, and helped supporting the findings and conclusions presented in this paper.

***Data Analysis***. The predominately qualitative data collected via *questionnaires*, in-*depth retrospective interviewing* and *participant observation* were evaluated via content analysis and *standard statistical methods.*

## III. RESULTS

The findings of this exploratory study are organized into three sections: First, a simple summary of Agile usage across project categories is presented. Second, the reaction of managers to the 12 Principles of Agile is summarized and discussed with focus on benefits, challenges, limitations and performance impact of managing agile. Third, the lessons learned from this study are summarized in a separate section under the heading of *Discussion and Lessons Learned for Effective Agile Management.*

### *Intensity of Agile Application Depends on Project Type*

One size does not fit all projects! This is one of the conclusions from this field study. Although the sample size is small and additional studies are necessary before more general conclusions can be reached, the results clearly show that the way Agile is used varies considerably with the type and size of each project as summarized in Table 3.

As shown in Table 3, none of the organizations in our sample uses Agile project management in its pure form (i.e. as defined by the literature). Even when committed to Agile as a principle management process, each organization defines the specific components of the project management process, such as sprints, daily scrum, cycle reviews and release plan, in their own format, consistent with their specific needs, business processes and organizational culture. The strongest most agile users are among the small and medium size projects (<50 team members) dealing with software and IT related activities. All of these organizations use Agile, at least in principle, with 66% using it almost in its pure format or just with some modifications. On the other side of the Agile usage spectrum are organizations outside of the software and IT community, especially those with larger projects (defined as teams of larger than 50 people). Many of these projects use Agile just "in principle" or "in spirit," but extensively modify the Agile methodology to be consistent with their established conventional project management processes, tools and techniques, needed to perform effectively in their unique business environment. 90% of the larger and/or non-IT projects fall into this "lesser agile category," while 7% of these project teams reverted back to primarily conventional project management methods after unsuccessfully trying Agile in their work environment. Finally, it is interesting to note that *all* of the organizations in our sample explored the usefulness of Agile for their project execution at some point in the past. The statistics in Table 3 shows the detailed breakdown of Agile usage across the various project types and sizes.

### *The Benefits, Challenges, Limitations and Performance Impact of Managing Agile*

During the interviews, questionnaires and observations of this field study project managers identified the benefits, challenges and limitations of Agile as they experienced them in their work environment. Using content analysis of the survey data, these experiences are summarized in Table4 with focus on the twelve guiding principles of Agile. A brief discussion of the implication to adaptability and scalability of Agile is given below. processes with standard industrial processes without either killing agility or compromising your carefully developed project communication and control systems.

**TABLE 3.** AGILE USAGE ACROSS INDUSTRIES

| Project Organization (Type of Work) | % | Level of Agile Application/Usage | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | 100% Pure Agile | Almost Pure Agile | Mostly Agile, but Modified | Agile in Principle, but mostly Trad'tl MG Process | Agile in Spirit, but Traditional MG Process | Tried Agile, reverted back to mostly Traditional | Never tried Agile |
| All organizations (Total Sample) | 100 | --- | 3% | 14% | 48% | 23% | 12% | --- |
| S/w & IT (small projects) | 9 | --- | 33% | 33% | 33% | --- | --- | --- |
| S/w & IT (large projects) | 17 | --- | --- | 17% | 50% | 17% | 16% | --- |
| Non s/w or IT (small project) | 26 | --- | --- | 11% | 33% | 56% | --- | --- |
| Non s/w or IT (large project) | 40 | --- | --- | 14% | 64% | 11% | 11% | --- |
| Mega Projects | 8 | --- | --- | --- | --- | 67% | 33% | --- |

***Agile principles are difficult to realize in large projects***. To be truly agile, the management process must be (i) iterative, that is take several cycles to complete, (ii) incremental, delivering the product and/or service in workable pieces, (iii) relying on self-organizing teams, and (iv) evolving regarding its work structures and processes as needed during the project lifecycle. While these requirements foster great flexibility and agility in changing environments, they are very difficult to realize in larger projects that require more execution formality and discipline to deal with the specific complexities, contractual requirements and project interfaces. Furthermore, many projects, such as airplane developments, advertisement campaigns, Olympic Games or aerospace missions, cannot be delivered incrementally. Yet, hybrid approaches, such as simulations, emulations, focus grouping, user-centered design and computer modeling, can often be substituted for "the real thing," achieving the same objective of early validation of deliverables and flexibility in changing environments.

***Long development cycles challenge Agile.*** Regardless of size or complexity, project with long execution cycles present a major challenge to Agile methodology which focuses on rapidly (or immediately) delivering functionality. This might be difficult to achieve without compromising long-range optimization of overall results.

***Integrating agile approaches into traditional project systems is difficult.*** Most of the featured benefits, such as flexibility, responsiveness to changing environments, active user involvement and iterative requirements verification, are quite obvious and very appealing to managers, but often difficult to realize in traditional or large project environments with established client relations and specific contractual procedures. One of the biggest challenges relates to process execution conflict. How do you merge lightweight

***Challenges to established standards, norms and processes of professional project management.*** Built on the premise of highly flexible team organizations, Agile is often seen unworkable in projects that need to be executed to meet specific results within given time and resource constraints. These projects follow by and large traditional standardized management processes. Managers of these projects argue that you can't have it both ways, maintaining a flexible organization with evolving work processes *and* control over established project requirements and deliverables. This argument is especially powerful for large projects and special categories of projects, such as government contracts, where the overall requirements and project scope must be established up-front and becomes the basis for performance measurements throughout the project life cycle. Yet, despite these challenges, some organizations are able to use Agile at least in part or in principle, even for very large and complex projects. Managers who were able to adapt Agile to these "traditional" project environments point out that Agile is not a "do as you want process." As for any organization development, it takes hard work and skillful leadership to introduce a general process template to a specific work environment, especially when dealing with large projects or projects outside of the software/IT category. The comment of a senior manager on a large project underlines this concern: "Some people think that Agile means that you can do anything you want. They use the features "ad hoc" rather than implementing the guidelines that lead to solid agile practices."

***Not all project activities fit Agile.*** Certain activities and their deliverables, such as documentation, training or other logistics support, are not part of the Agile. Applying Agile to these activities, whether part of a project or stand-alone, requires major adjustment. However, with some creativity Agile can often be adapted. As stated by one project manager responsible for the implementation of a large training program: "I hear people saying all the time that Agile is not meant for this kind of project. The reality is that no method will guarantee you success. You have to fine-tune it to your specific situation. I select the pieces that are appropriate for my projects. Agile gives me a framework for interacting with my user community, testing out deliverables before we go to a major training session."

***Not all challenges are limitations.*** Challenges and barriers to Agile are perceptions, not necessarily true limitations. Much of the criticism of Agile is based on the assumption that it does not work in a particular organizational culture or work process, because the culture or process is fixed and not under the control of the project manager. First, this is not true. But, more importantly, the process of Agile is not a rigid template, but a guideline that must be adapted to a specific project situation, especially if the situation is outside the framework for which Agile was originally designed for. As explained by a senior manager of a large transport system development: "Just because you're following the process doesn't mean you're doing it right. You really need to think creatively and have talented people who understand the objectives of the Agile principles to adapt the ideas to work in our environment, and to do it right. If you're not involving your team, and constantly evaluating your practices what works, what doesn't and what needs to be fine-tuned, you're likely to fail."

## IV. CONCLUSION

The world changed considerably over the past two decades to a faster-paced, more competitive global business environment. Many of the contemporary project management systems that evolved with this changing environment respond to the need for faster, cheaper and more flexible project execution. Agile is possibly one of the most popular, most talked about project execution methods that emerged at the beginning of this millennium. It was designed by software developers for more effective execution of software-intensive projects. While most of the software and IT communities have embraced the concurrent and rapid development processes associated with Agile methodology, other project managers, in spite of finding the principles and operational philosophies of Agile highly attractive, are struggling with implementing the method into traditional project

**TABLE 4**. REACTION OF MANAGERS TO THE 12 PRINCIPLES OF AGILE

| AGILE PRINCIPLE | | MANAGEMENT REACTION |
|---|---|---|
| 1. | Customer satisfaction by rapid delivery of useful software | ***Positive:*** Customer satisfaction is critical to project success and an important measure of project performance.<br>***Negative:*** Focus on rapid delivery is not a practical means or option for many large and complex projects, especially those outside of IT.<br>***Management Challenges:*** Adapting the "spirit" of the principle to the given project situation, consistent with its organizational culture. Assuring that customers are involved in the project execution process and participate in any scope/time trade-offs and the rollout of deliverables. |
| 2. | Welcome changing requirements, even late in development | ***Positive:*** Changing requirements are a reality of our constantly changing and evolving landscape regarding technology, markets and regulations. Project teams must deal with these changes as they emerge to ensure that the project deliverables are relevant to the application objectives and customer needs. Agile methods accept the fact that changes will happen and use methods that deal with these changes in the least disruptive way.<br>***Negative:*** Changes in one area often affect other areas and can destabilize the whole project unless they are carefully coordinated and controlled. Changes can also be very costly affecting established budgets and schedules.<br>***Management Challenges:*** Changes need to be to be carefully managed, negotiated and controlled. The project leadership team must be disciplined about what changes to allow, how to optimize cost-benefits. |
| 3. | Working software is delivered frequently (weeks rather than months) | ***Positive:*** Agile development methods accelerates the delivery of results throughout the project lifecycle. This helps in early field testing of the end product and in generating business value early and throughout the project lifecycle.<br>***Negative:*** Delivering incremental results may be inefficient or outright impossible for some projects. It also shifts the focus from achieving overall project objectives to short-term results, especially a problem for large and complex projects.<br>***Management Challenges:*** Continuous iterative project planning and feedback is required to achieve desired project results and to maximize value throughout the development process aligned with the business objectives. |
| 4. | Working software is the principal measure of progress | ***Positive:*** Focusing on end results and overall objectives is an effective management philosophy for any kind of project.<br>***Negative:*** Narrow focus on short-term results may compromise overall project performance, customer satisfaction and business performance.<br>***Management Challenges:*** Defining workable results for non-IT projects, and satisfying contractual deliverables while managing toward overall, long-term project performance. |
| 5. | Sustainable development, able to maintain a constant pace | ***Positive:*** Focus on established schedules and milestones keeps the project moving forward, while dealing with issues separately. This iterative development allows building the system incrementally, starting with a base system with primary features, delivering testable results early, while gradually adding more features until the entire system is functional and completed. This also provides opportunities for improvement in succeeding iterations based on previously learned lessons.<br>***Negative:*** An iterative development may be more costly or impossible for some projects, especially those involving hardware or infrastructure; compromise overall project performance, customer satisfaction and business performance.<br>***Management Challenges:*** Adapting the "constant pace" philosophy to larger projects with multiple independent deliverables, especially for non-IT projects. |
| 6. | Close, daily cooperation between business people and developers | ***Positive:*** Effective interdisciplinary communications and collaboration is desirable and beneficial for any kind of project, resulting in more agile execution and better alignment with the business objectives.<br>***Negative:*** The existing company culture might impede the ability to implement this philosophy which also shifts power and accountability from the project manager to more sharing with the business functions, resulting in less central project control.<br>***Management Challenges:*** Adopting cooperative processes within the enterprise culture without compromising necessary managerial processes and controls. |
| 7. | Face-to-face conversation is the best form of communication (co-location) | ***Positive:*** No argument, very desirable for any kind of project.<br>***Negative:*** For virtually any project, face-to-face communications must be augmented with various other forms of communication (i.e. IT-based). Co-location can be very expensive or even impossible (e.g. globally dispersed project teams). Face-to-face communication is no substitute for documentation, such as work in progress, test results, legal and customer requirements.<br>***Management Challenges:*** Promoting face-to-face without compromising essential written communications and incurring excessive cost. Optimizing the "cost-benefit" of face-to-face communications. |
| 8. | Projects are built around motivated individuals, who should be trusted | ***Positive:*** No argument, very desirable for any kind of project.<br>***Negative:*** While most project managers understand and buy-into this argument, team members cannot always be recruited by their personality traits, but are selected or assigned by their skill sets. Furthermore, project leaders often have to work with teams from contractor, supplies, government or partner organizations over whom they have little or no control regarding team composition and development.<br>***Management Challenges:*** Building motivated teams despite the above concerns and limitations. |
| 9. | Continuous attention to technical excellence and good design | ***Positive:*** No argument, very desirable for any kind of project. Very consistent with Total Quality Management (TQM) philosophy.<br>***Negative:*** None.<br>***Management Challenges:*** To make it happen despite of time and resource pressures, contingencies and changes. |
| 10. | Simplicity—the art of maximizing the amount of work not done—is essential | ***Positive:*** Simplicity in design and work process has many benefits (i.e. lower implementation risks, conflict, execution cycle, cost) for many projects.<br>***Negative:*** Project leaders often don't control functions that influence simplicity. Work simplification is often not possible without sacrificing performance.<br>***Management Challenges:*** Simplifying the project work and its processes without compromising performance. |
| 11. | Self-organizing teams | ***Positive:*** Defined as a group of motivated individuals, who work together toward a goal with the ability and authority to make decisions and adapt to changing conditions. Self-organizing teams have been recognized as beneficial and desirable for any kind of project.<br>***Negative:*** The concept is difficult to realize for larger teams that require more formality in their organization and work process. The concept requires a shift in power from project leader to the team members (power sharing) which results in less central control often needed to manage (especially large projects) toward desired goals and objectives and to align the project with enterprise strategy.<br>***Management Challenges: B***uilding self-organizing teams despite the above concerns and limitations requires sophisticated organizational and managerial skills to recruit and develop a team that has the competencies, mutual trust, respect and collaboration necessary to become self-organizing. |
| 12. | Regular adaptation to changing circumstances | ***Positive:*** No argument, very desirable for any kind of project. It is also a characteristic of the self-organizing team and the change-orientation promoted in Principle #2.<br>***Negative:*** While changes are often a reality of project life that needs to be dealt with, they are also associated with opportunities, risks and costs. They need to be carefully managed to optimize results. A "one-size-fits-all" open adaption to changing circumstances can have disastrous consequences, especially for larger, more complex projects.<br>***Management Challenges:*** Stabilize the project environment to minimize undesirable changes, effectively manage needed changes while encouraging team members to identify opportunities for beneficial change and to collaborate with necessary change situations. |

environments. Many of these challenges relate to the incompatibility of lightweight Agile processes with well-established standard industrial processes used for large projects and most projects outside the software/IT community. These incompatibilities include many key areas of the project management process such as developing requirements, progress reviews, work processes, performance measures, progress payments, documentation, and delivery of results.

We are in a transition period where an increasing number of managers recognize the need for agile execution. However, this new lightweight method causes major issues for larger and non-software/IT sector projects that are executed within the framework of well-established conventional methods and standards such as ISO, PMBOK and MIL for project planning, organizing and execution. The challenge is to *align* these standardized traditional methods with the processes and principles of Agile without compromising their integrity for disciplined controlled execution. Several professional organizations, such as Carnegie Mellon's Capability Maturity Model Integration (CMMI) program and PMI's Agile Certified Practitioner (PMI-ACP®) program are supporting the project management community in their efforts of integrating and synchronizing

the two systems, and in scaling Agile to larger projects.

Some suggestions that emerged from the broader context of this study include: (1) Introduce Agile to your organization incrementally. Start with agile practices that already support existing processes and organizational cultures; (2) examine the various components of your project management process for opportunities for applying Agile principles without compromising existing management processes and controls; identify compatible and incompatible assumptions, and encourage synergism between agile and traditional methods; (3) examine customer interfaces and contracting practices, redesign procedures to support agile execution; (4) examine progress measurement, reviews and payment practices for realignment with agile execution; (5) win the hearts and minds and support of senior management, convincing them that Agile is a more effective way of executing projects leading to higher success rates and customer satisfaction; (6) pay attention to people issues, such as empowerment, collaboration, commitment and ownership which are at the backbone of Agile and crucial to its successful practice.

Taken together, Agile has great potential for improving project management effectiveness in our ultra-competitive, fast-changing business environment. In spite of the challenges, the principles and basic philosophy of Agile can be integrated into traditional project management processes. However, to be effective, change leaders must go far beyond issuing new procedures and guidelines. They have to skillfully prepare the organization and manage the introduction of the new way of project execution. Each component of Agile, including underlying assumptions, must be carefully examined to determine the degree of adaptability, and redesigned and fine-tuned if necessary to fit into the existing management system. Selective, incremental implementation is strongly recommended. Often, companies combine, integrate and synchronize Agile *and* traditional processes to create a unique agile hybrid system which fits specific project situations, together with their people, organizational cultures and the total enterprise business environment. In fact, many projects incorporate software, hardware, logistics and other subsystems. It might be appropriate for both Agile and traditional project management communities to collaborate toward a common ground, combining the strength of both systems.

While no single set of broad guidelines exists that guarantees success for implementing Agile principles into traditional project environments, the process is not random! A keen sensitivity to the type of projects affected and the organizational dynamics and its culture, can foster an environment conducive to operational change and improved project performance.

## REFERENCES


[1] Atnahene-Gimo, K (2003) "The effects of centrifugal and centripetal forces on product development speed and quality," *Academy of Management Journal*, Vol. 43, No. 3 (June), pp. 359–373.

[2] Beck, K. et al 17 authors (2001). *Manifesto for Agile Software Development*, Nashville, TN: Agile Alliance.

[3] Boehm, B. (1988). "A spiral model of software development and enhancement," *Computer*, Vol. 21, No. 5 (May), 61-72.

[4] Boehm, B., & Turner, R. (2005). Management challenges to implementing agile processes in traditional development organizations. *Software, ieee*, *22*(5), 30-39.

[5] Bstieler, L. (2005). The moderating effects of environmental uncertainty on new product development and time efficiency, *Journal of Product Innovation Management*, 22(3), 267-284.

[6] Ceschi, M., Sillitti, A., Succi, G., & De Panfilis, S. (2005). Project management in plan-based and agile companies. *Software, IEEE*, *22*(3), 21-27.

[7] Chandramouli, S., & Dutt, S. (2012). *PMI: Agile Certified Practitioner*. Pearson Education India.

[8] Chow, T., & Cao, D. B. (2008). A survey study of critical success factors in agile software projects. *Journal of Systems and Software*, *81*(6), 961-971.

[9] Constantine, L. L., & Lockwood, L. (2002). Process agility and software usability: Toward lightweight usage-centered design. *Information Age*, *8*(8), 1-10.

[10] Cooper, R. (2008). "Perspective: The Stage-Gate® idea-to-launch process—update, what's new, and NexGen systems," *Journal of Product Innovation Management*, Vol. 25, No. 3 (May), pp. 213-232.

[11] Danneels, E. and Kleinschmidt, E.J. (2001). Product innovativeness from the firm's perspective. *Journal of Product Innovation Management*, *18*(6), 357–374.

[12] DeCarlo, D. (2004). *Extreme Project Management*, San Francisco, CA: Josse-Bass

[13] Denker, S., Steward, D., and Browning, T. (2001) "Planning concurrency and managing iteration in projects," *Project Management Journal*, Vol. 32, No. 3 (Sep), pp. 31–38.

[14] Dourado, J., Silva, R. and Silva, A. (2011). "Concurrent engineering: An overview regarding major features and tools," *Business Excellence,* Vol. **5,** No. 2, pp. 67-82.

[15] Eisenhardt, K. M. (1989). Building theories from case study research. *Academy of Management Review*, *14*(4), 532–550.

[16] Fister, S. (2012). The evolution of agile. PM Network, v. 26, no. 1 (Jan), p. 28-33.

[17] Flahiff, J. (2011). Integrating agile in a waterfall world. PMI Global Congress 2011-EMEA. Proceedings, TRN02EMEA2011.PDF.

[18] Galliers, R., & Leidner, D. E. (Eds.). (2003). *Strategic Information Management: challenges and strategies in managing information systems*. Routledge.

[19] *Gerwin, D. and Barrowman, N.* (2002) "An evaluation of research on integrated product development," *Management Science*, Vol. 48, No.. 7 (July); pp. 938-954.

[20] Githens, G. (1998) "Rolling wave project planning," Proceedings, 29th Annual Symposium of the Project Management Institute, Long Beach, CA (October 9–15).

[21] Glaser, B.G., and Strauss, A L. (1967). *The discovery of grounded theory: Strategies for qualitative research*. Chicago: Aldine.

[22] Goodpasture, J. C. (2010). *Project management the agile way: Making it work in the enterprise*. J. Ross Publishing.

[23] Haque, B., Pawar, K., and Barson, R. (2003) "The application of business process modeling to organizational analysis of concurrent engineering environments," *Technovation*, Vol. 23, No. 2 (Feb), pp. 147–162.

[24] Highsmith, J. (2009). *Agile project management: creating innovative products*. Pearson Education.

[25] Highsmith, J., & Fowler, M. (2001)."The agile manifesto," *Software Development Magazine*, *9*(8), 29-30.

[26] Irani, Z. (2002). Information systems evaluation: navigating through the problem domain. *Information & Management*, *40*(1), 11-24.

[27] Kontio, J., Hoglund, M., Ryden, J., & Abrahamsson, P. (2004, May). Managing commitments and risks: challenges in distributed agile development. *Software Engineering, 2004. ICSE 2004. Proceedings. 26th International Conference on* (pp. 732-733). IEEE.

[28] MacCormack, A., Verganti, R., and Iansiti, M. (2001). Developing products on internet time. *Management Science*, *47*(1), 22–35; *Engineering Management Review*, *29*(2), 90–104.

[29] McNamara, Gerry; Moon, Henry and Bromiley, Philip (2002). "Banking on Commitment: Intended and Unintended Consequences of

an Organization's Attempt to Attenuate Escalation of Commitment." *Academy of Management Journal,* Vol. 45, No. 2, pp. 443-452

[30] Mountain Goat Software (2013). "What is Agile." http://www.mountaingoatsoftware.com/agile/agile-project-management

[31] *Nee, A. and Ong, S. (2001)* "Philosophies for integrated product development," *International Journal of Technology Management***,** Vol. 21, No. 3, pp. 221–239.

[32] Nellore, R. and Balachandra, R. (2001) Factors influencing success in integrated product development (IPD) projects. *IEEE Transactions on Engineering Mgmt*, *48*(2), 164–173.

[33] Nerur, S., Mahapatra, R., & Mangalaraj, G. (2005). Challenges of migrating to agile methodologies. *Communications of the ACM*, *48*(5), 72-78.

[34] Prasad, B. (2002) "Toward life-cycle measures and metrics for concurrent product development," *International Journal of Computer Applications in Technology*, Vol. 15, No. 1/3, pp. 1–8.

[35] Prasad, B. (2003) "Development of innovative products in a small and medium size enterprise," *International Journal of Computer Applications in Technology*, Vol. 17, No. 4, pp. 187–201.

[36] Prasad, G. and Rao, B. (2004). "Concurrent engineering in a pharmaceutical firm: a case study of Dr Reddy's Laboratories Ltd," *International Journal of Manufacturing Technology and Management,* Vol. 6, No. 3/4, pp. 280-290.

[37] Ramesh, B., Cao, L., Mohan, K., & Xu, P. (2006). Can distributed software development be agile?. *Communications of the ACM*, *49*(10), 41-46.

[38] Rigby, Darrel K. (1995) "Managing the management tools," *Engineering Management Review (IEEE)*, Vol. 23, No.1 (Spring), p. 88–92.

[39] Riss, U. V., Rickayzen, A., Maus, H., & van der Aalst, W. M. (2005). Challenges for business process and task management. *Journal of Universal Knowledge Management*, *2*, 77-100.

[40] Rubin, K. S. (2012). *Essential Scrum: A Practical Guide to the Most Popular Agile Process*. Addison-Wesley Professional.

[41] Smith, R. (1997). "The historical roots of concurrent engineering fundamentals," *IEEE Transactions on Engineering Management*, Vol. 44, No. 1 (February), pp. 67-78

[42] Thamhain H. (2013). "The role of commitment for managing complex multinational projects. *International Journal of Innovation and Technology Management*, Vol. 12, No. 2 (Mar).

[43] Thamhain, Hans (2009). "Leadership lessons from managing technology-intensive teams." *International Journal of Innovation and Technology Management*, Vol. 6, No. 2 (Jun), pp.117-133.

[44] Thamhain, Hans (2011). "Critical success factors for managing technology-intensive teams the global enterprise." *Engineering Management Journal*, Vol. 23, No. 3 (Sep), pp.30-36.

[45] Thamhain, Hans (2012). "The Changing Role of Team Leadership in Multinational Project Environments." *Revista de Gestão e Projetos (Project Management Journal of Brazil),* Vol.3, No.2 (Dec), pp.4-38.

[46] Thamhain, Hans (2013). "Managing risks in complex *projects." Project Management Journal (PMJ)*, Vol. 44, No. 2 (April), pp. 20-36.

[47] Verganti, R. and Buganza, T. (2005). Design criteria: Designing for life-cycle flexibility in internet-based services. *Journal of Product Innovation and Management*, *22*(3), 223–237.

[48] Wu, S., Fuh, J., and Nee, A. (2002) "Concurrent process planning and scheduling in distributed virtual manufacturing," *IIE Transactions*, Vol. 34, No. 1 (Jan), pp.77–89.