UNIVERSITY OF QUEBEC AT MONTREAL

HOW ARE AGILE PROJECT MANAGEMENT PRACTICES CONSISTENT WITH A CREATIVE WORK ENVIRONMENT: *AN EXPLORATORY STUDY WITHIN THE INTERNATIONAL VIDEO-GAME INDUSTRY*

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COMMENT LES PRATIQUES EN GESTION DE PROJET AGILE SONT-ELLES PROPICES À UN ENVIRONNEMENT DE TRAVAIL CRÉATIF : UNE ÉTUDE EXPLORATOIRE DANS L'INDUSTRIE INTERNATIONALE DES JEUX VIDÉOS

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RÉSUMÉ

Ce projet de recherche présente de nouvelles données empiriques qui évaluent l'impact des pratiques de gestion de projet dans un environnement de travail créatif. L'étude se concentre sur la gestion de projet de type Agile avec Scrum en raison de sa méthodologie légère et flexible qui se prête bien au développement de nouveaux produits et de gestion de projet en technologie de l'information. Avant cette étude, il y avait un manque de données empiriques permettant de confirmer ou infirmer des proclamations supportant les performances des pratiques de gestion de projet Scrum. Tous, professionnels comme académiciens pouvaient donc se questionner sur les mérites des pratiques de gestion Scrum. Ce projet de recherche atténue ce vide au travers d'une étude exploratoire réalisée au sein d'une entreprise internationale de développement de jeux vidéo.

Dans ce projet de recherche, nous avons développé un nouveau modèle de mesure pour les pratiques de gestion de projet Scrum - le premier dans cette catégorie. Nous avons utilisé le modèle 'KEYS to creativity' (Amabile, 1996) pour mesurer la créativité dans un environnement de travail. Les résultats démontrent comment les pratiques Scrum contribuent à un environnement de travail créatif.

Mots-clés: project management, agile, scrum, creativity, keys framework

SUMMARY

This research project presents new empirical data on the impacts of project management practices on a work environment that is conducive to creativity. We focus on Agile project management with Scrum for its reputation as a light and flexible methodology that has been designed to meet the unique needs of new product development and information technology projects. Prior to this study, there had been a void of empirical evidence to support or challenge these claims that Scrum project management practices perform well in such projects. Both professionals and academics alike were left questioning the merits of Scrum practices. This research project relieve this void through an exploratory study conducted within an international video-game development company.

In this research project, we develop a new measurement model for Scrum project management practices - the first of its kind. We call upon the KEYS to creativity model (Amabile, 1996) to measure creativity in the workplace. Our findings present how Scrum practices contribute to a creative work environment.

Key words: project management, agile, scrum, creativity, keys framework

INTRODUCTION

Interest in the subject of Agile, Scrum, and creativity stems from the researcher's ten years of professional experience in software development and project management. Having worked in small, medium, and large organizations - continuously seeking to innovate their products and improve their processes - project management theory seemed to raised more questions than it answered.

The goal of this research paper is to inform its audience of academics and practitioners alike who seek empirical evidence on Agile project management and its relation to creative work environments - and indirectly to innovation. There is much research supporting the theory that creative work environments positively impact the generation of novel ideas and innovation (Mathisen, 2004). Key factors in this relationship are 1) employee autonomy, 2) access to sufficient resources, and 3) freedom to follow untraditional working methods, processes, or practices (Amabile, 1996). We also know that such projects as new product development, information technology, and video-game development are increasingly dependent on innovation in today's fast-paced, highly competitive global economy. We are also seeing that in many cases traditional project management practices are not delivering satisfactory results in these types of projects (Shenhar, 2007; Duggal, 2001). It is argued that the rigid, predetermined, cookie-cutter approach of traditional project management may not lend itself well to such dynamic, evolutionary undertakings. The fact that such projects are not only characterized by high uncertainty, frequently changing requirements, and emerging technologies, but that they actually thrive on such condition, clearly contradicts the assumptions of traditional project management - where specifications are best "written in stone" upfront. In short, innovation projects are not defined, they emerge (Williams, 2005).

This has lead many companies to seek alternative project management methodologies. In recent years, Agile project management practices have gained in popularity. The hypothesis is that Agile's lighter, more informal, and more flexible management style is more consistent with creativity and innovation. The question, however, remains: Are Agile project management methodologies really a better choice? and if so, why?

As we see in figure i.1 below, the research goals of this study is based upon the following logic: It is accepted that fostering individual and team creativity in the workplace promotes the generation and production of novel and innovative products and services (Amabile, 1996). It is also agreed that new product development, information technology, and specifically video-game development projects require innovation (Takeuchi and Nonaka, 1986; Shenhar and Dvir, 2007). The literature also recognizes the trend towards Agile project management methods in such industries and projects (Schwaber, 2004, 2007). Finally, there is evidence that Agile project management methods are successfully delivering many such unique projects (Baskerville, 2006; Berger, 2007; Boehm, 2005; Karlstrom, 2005). Therefore, this study hypothesizes that Agile project management practices are consistent with creative work environments. Should this hypothesis be proven true, it would provide some explanation as to why Agile methods might be well suited to innovation-dependent projects.

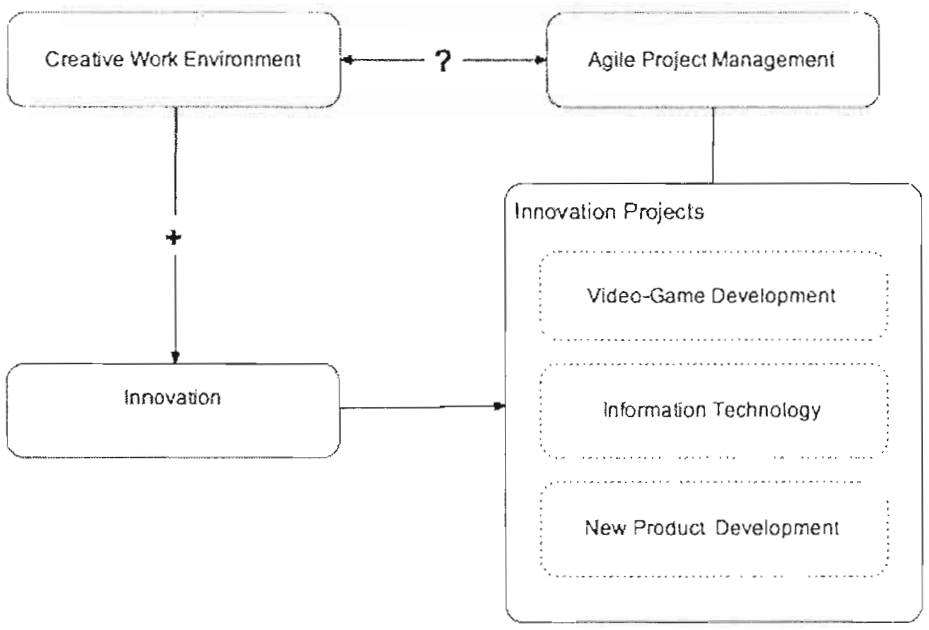


Figure i.1 Research Interest

In our highly competitive economy, almost all companies are facing increasing challenge to produce new, competitive products and services; and to produce them faster. Many of them are looking to their project management capabilities to deliver these results. (Shenhar and Dvir, 2007; Duggal, 2001).

Unfortunately, many companies are finding that traditional project management practices are not yielding satisfactory results in these environments. Projects fail, and competitive advantage remains elusive (Williams, 2005). As a result, companies are looking for alternate solutions, and many are turning to Agile project management. Agile began to surface in the late 1990s in software development communities, and has grown in popularity in part due to its "light" methodology - in sharp contrast to the "heavy", defined methodologies of traditional project management. It is, therefore, of great interest to companies looking for new solutions to their project

management problems to better understand how adopting Agile practices might better satisfy their needs.

Referring to companies that rely heavily on innovation, Bergman (cited in Dinsmore & Cooke-Davies, 2006) state that "The demands for more efficient and flexible project management have increased", leading them to move towards their own "in-house" project management models, and away from traditional out-of-the-box models (p.275).

Dinsmore and Cooke-Davis (2006) spotlight project management in the IT industry as "several orders of magnitude more difficult" than traditional industries (p.271), further expressing the need to explore methodologies that are better suited to its uniqueness.

In chapter one, we present a literature review of traditional project management, Agile project management, and creativity in the workplace as the foundation of this research. Chapter two presents the problem statement and research objectives that inspire this project. Chapter three will construct the conceptual framework and hypotheses upon which the reasoning and research process are based. Our research methodology is detailed in chapter four. Chapter five presents the new Scrum measurement model that was developed in this research project. Finally, chapter six presents our results, and in chapter seven we discuss the findings.

GLOSSARY

Acronym	Full Text
APM	Agile Project Management
CMMI	Capability Maturity Model Integration
IT	Information Technology
NPD	New Product Development
OGC	Office of Government Commerce
PM	Project Management
PMBOK	Project Management Body of Knowledge
PMI	Project Management Institute
PRINCE	Projects in Controlled Environments
R&D	Research and Development
SCRUM	Agile Project Management with Scrum
SEI	Software Engineering Institute

CHAPTER I

LITERATURE REVIEW

Chapter one presents a review of the existing literature in the three primary fields that concern this research, namely 1) Traditional project management, 2) Agile project management, and 3) Creativity in the workplace. We will see that there is a void of empirical data to help us understand when and why we might be well served to implement Agile management practices. This research attempts to address, and ideally relieve, this void.

1.1 TRADITIONAL PROJECT MANAGEMENT

A review of traditional project management is necessary in order to effectively understand and position Agile project management in contrast. Agile was developed to address certain shortcomings of its traditional counterpart. It is therefore important to understand each individually, before evaluating their differences. Three of the most popular traditional project management models are presented, each representing a complementary perspective of project management. The Project Management Body of Knowledge (PMBOK) (PMI, 2008) is a generalized body of knowledge based in the United States. In the United Kingdom we find the work of the Office of Government Commerce (OGC) entitled "Projects in Controlled Environments" in its second edition (PRINCE2) (OGC, 1996) which describes a project management process and methodology. Lastly, we present the Software Engineering Institute's (SEI) "Capability Maturity Model Integration" CMMI (SEI, 2002) as an example of a project management process maturity model.

1.1.1 PROJECT MANAGEMENT BODY OF KNOWLEDGE

The PMBOK (PMI, 2008) - an acronym for the "Project Management Body Of Knowledge" - is the basis of the Project Management Institute's internationally recognized professional standards and certification program. With more than 2 million copies in circulation, and over 265 000 members in over 170 countries, the PMBOK is one of the most recognized project management publications in the world[1]. This guide claims to be "applicable to most projects most of the time" (p.3), and defines project management as "the application of knowledge, skills, tools and techniques to project activities to meet project requirements" (p.8).

The PMBOK defines nine knowledge areas in project management; namely the management of integration, scope, time, cost, quality, human resources, communication, risk, and procurement. See figure 1.1 below for more details.

[1] Internet site: www.pmi.org accessed on November 25, 2008

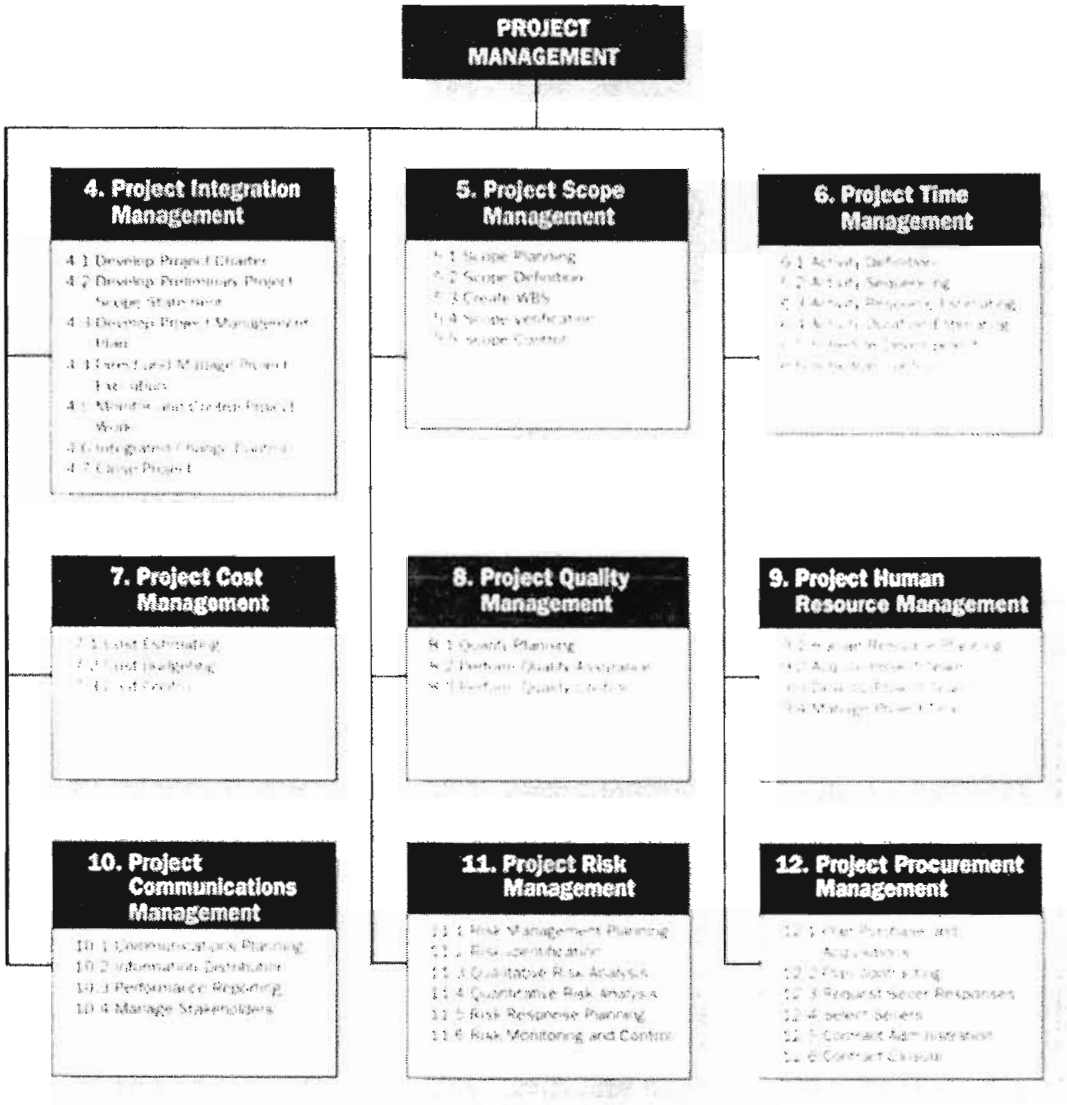


Figure 1.1 Project Management Knowledge Areas and Processes

(PMI, 2008, p.26)

Furthermore, the PMBOK teaches project management as the linear sequence of project initialization, planning, execution, monitoring and controlling, and closure - as illustrated in figure 1.2 below.

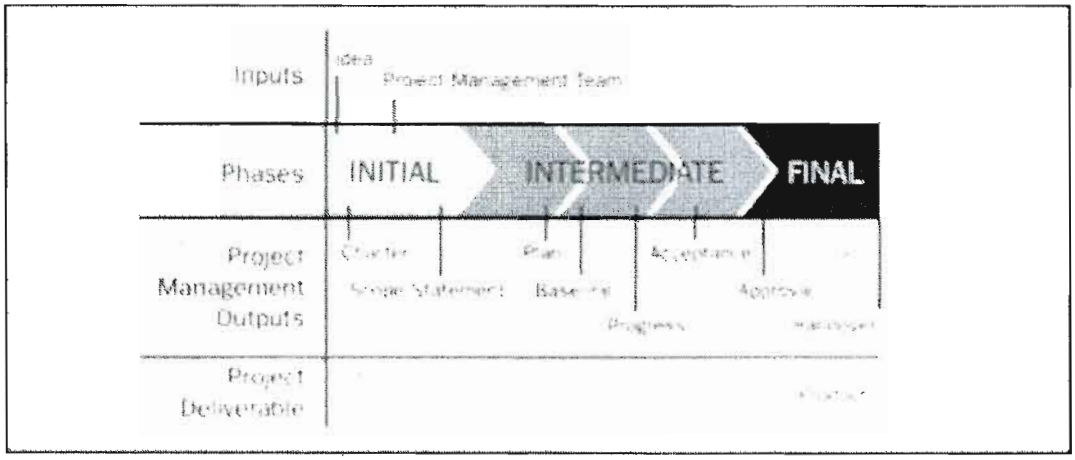


Figure 1.2 PMBOK Project Life-cycle

(PMI, 2008, p.38)

1.1.2 PROJECTS IN CONTROLLED ENVIRONMENTS

PRINCE2 (OGC, 1996) - an acronym for "PRojects IN Controlled Environments" - is a process-based method for effective project management and the de facto standard used extensively by the United Kingdom government and widely recognized internationally [2].

Developed in 1996, the distinguishing features of the PRINCE2 standard are:

- Its focus on business justification
- A defined organizational structure for the project management team
- Its product based planning approach
- Its emphasis on dividing the project into manageable and controllable stages
- Its flexibility to be applied at a level appropriate to the project

[2] Internet site: www.prince2.com accessed November 25, 2008

As is evident from the schematic diagram of figure 1.3 below, PRINCE2 is a highly structured, predefined, and detailed process for managing projects (enlarged version in appendix A).

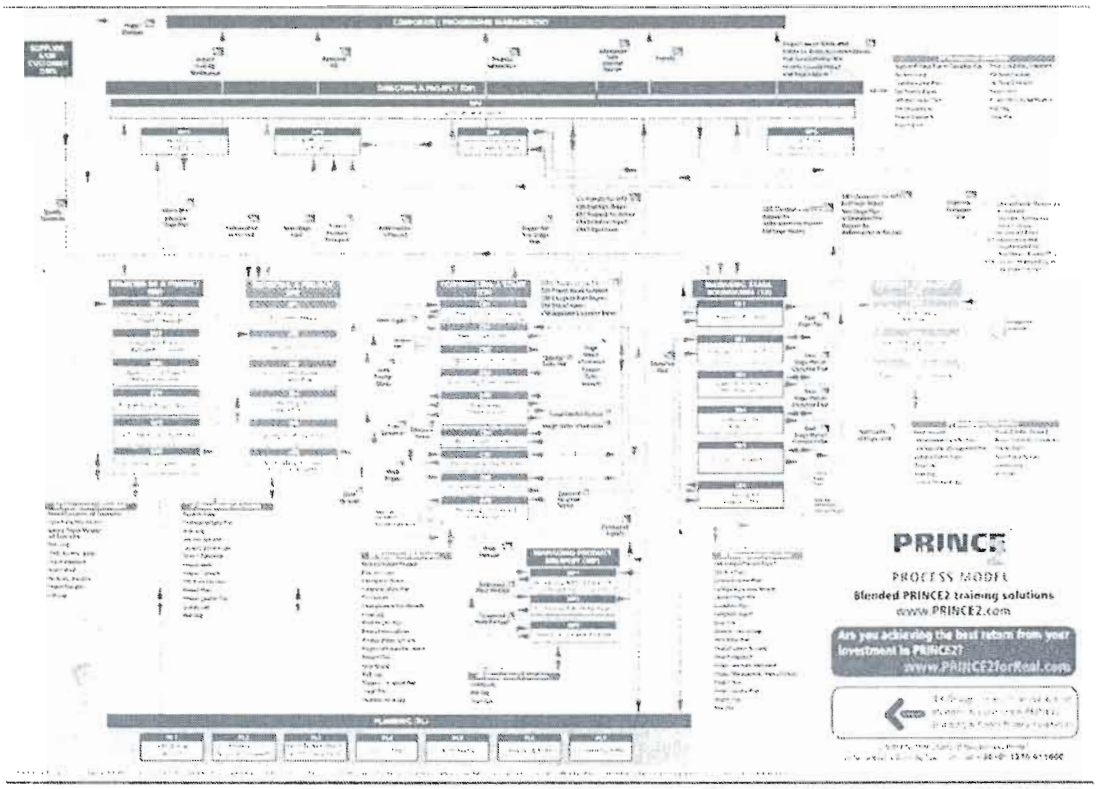


Figure 1.3 PRINCE2 Process Model

(OGC, 1996)

1.1.3 CAPABILITY MATURITY MODEL INTEGRATION

CMMI (SEI, 2002) - acronym for Capability Maturity Model Integration - was developed by the Software Engineering Institute (SEI) in association with Carnegie Mellon University in 1996. The SEI is a research and development center funded by the U.S. Department of Defense.

The CMMI model was developed to provide a basis upon which companies' processes could be evaluated before qualifying as suppliers of the U.S. Department of Defense. The goal was to ensure a level of quality in the work and goods supplied by their subcontractors. Even though there have been many maturity models developed over the years, the CMMI is one of the most internationally recognized and highly implemented certification processes in the world (Thomas and Mullaly, 2008).

Included in the CMMI are its eight project management processes:

- Project Planning
- Project Monitoring and Control
- Supplier Agreement Management
- Integrated Project Management for IPPD (or Integrated Project Management)
- Risk Management
- Integrated Teaming
- Integrated Supplier Management
- Quantitative Project Management

Figures 1.4 and 1.5 show the basic and advanced project management processes, respectively, as well as their inter-relationship:

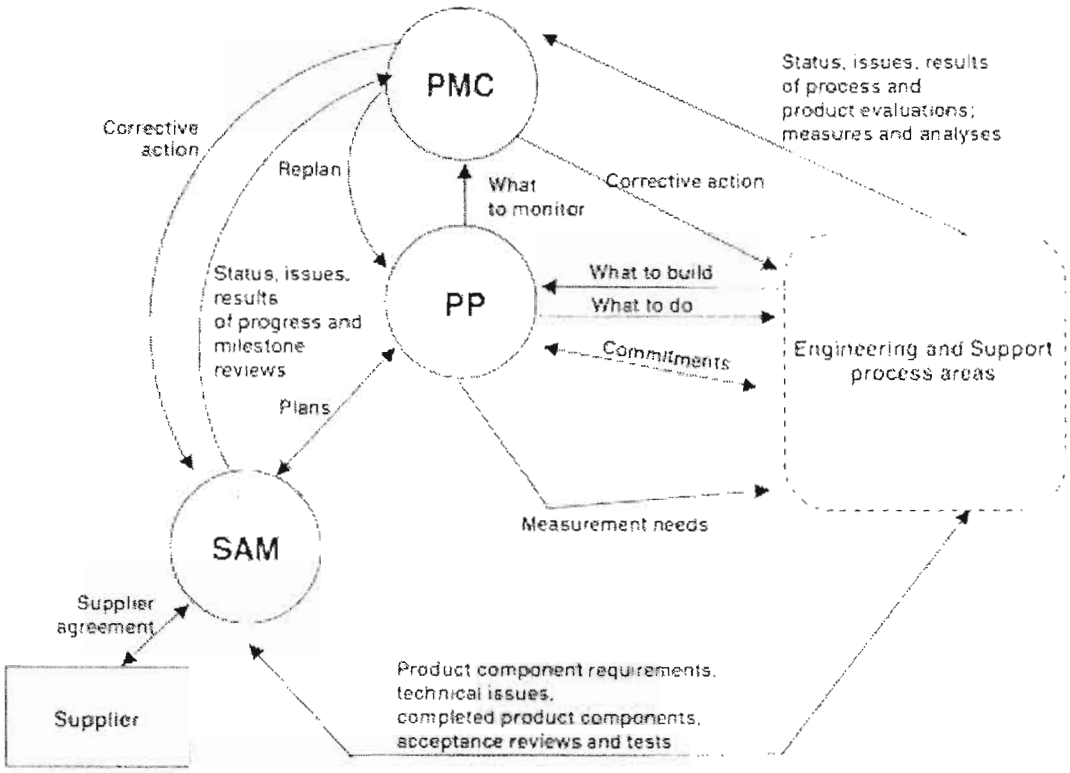


Figure 1.4 CMMI Basic Project Management Process

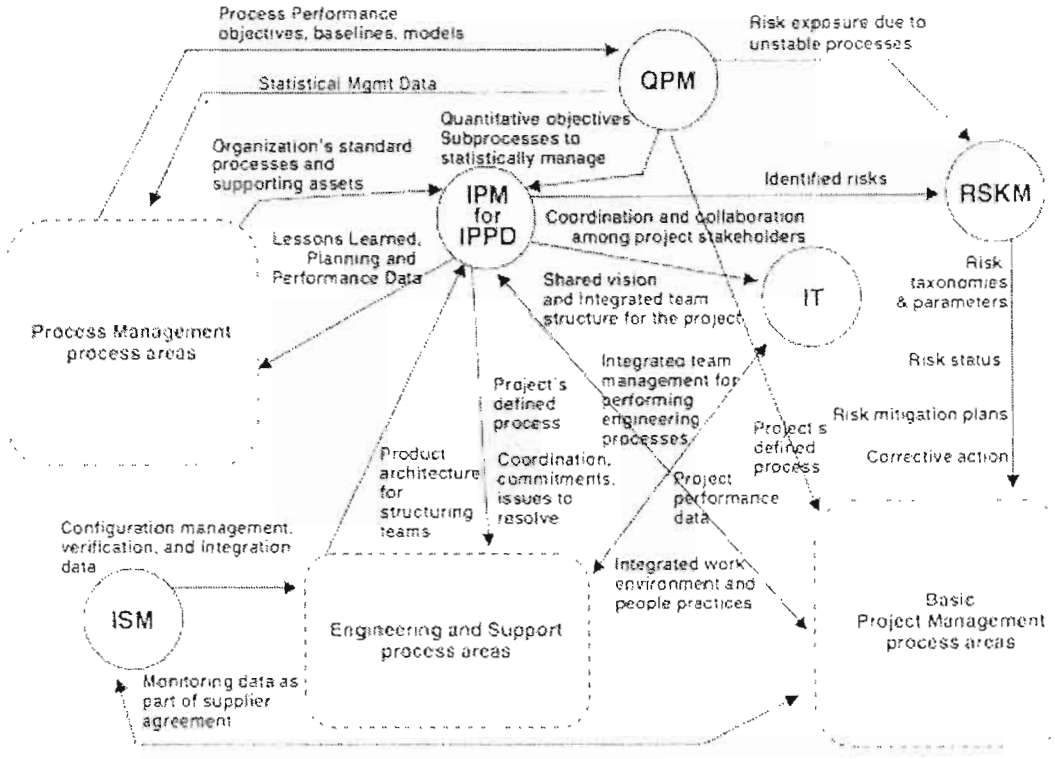


Figure 1.5 CMMI Advanced Project Management Process

Furthermore, as it is a maturity model, the CMMI defines 5 levels of effectiveness against which each process is measured. Each level increases the required rigor and repetitiveness of the process. The 5 levels of maturity are:

1. Initial
2. Managed
3. Defined
4. Quantitatively Managed
5. Optimizing

Consistent with other traditional standards, the CMMI teaches a complex, predetermined formula for successful project management. Furthermore, in order to master these processes, they must be executed with increasing rigor and repetition.

1.1.4 SUMMARY

Traditional project management processes describe complex relationships between numerous processes and practices, that favor predetermined, linear progression through rigorous phases. These characteristics can arguably stifle creativity and innovation (Amabile, 1996) and may be less well suited to projects that must embrace change and uncertainty. As such, there is much interest in a better understanding of "lighter" alternatives that may foster a creative work environments.

1.2 THE NEED FOR INNOVATIVE PROJECT MANAGEMENT METHODS

This section refers to current literature that speaks to the need for innovation in project management practices. The authors cited below identify weaknesses in traditional project management when applied in environments requiring innovation.

1.2.1 SYSTEMIC MODELING

In his research on chronic project overruns, Williams (2005) found that traditional project management practices were particularly poor at dealing with three characteristics:

1. Structural complexity
2. Uncertainty
3. Tight time-constraints

He argues that conventional approaches make assumptions that directly contradict their applicability to these situations. Firstly, conventional methods assume simplicity - such that the whole system can be managed as the sum of its parts. This is evident from the Work Breakdown diagrams that divide a project's deliverables into a hierarchy of tasks. What is difficult to foresee in these breakdown structures are the interdependencies and relations between the parts, the integrations that makes the whole greater than the sum of its parts.

Secondly, Williams (2005) identifies uncertainty as incompatible with the plan-based assumption that the goal and the means of achieving the goal can be laid out in a perfect plan prior to execution. Uncertainty is a natural part of project's uniqueness - it is, after all, defined as a temporary endeavor undertaken to create a "unique product, service, or result" (PMI, 2008).

Lastly, tight time-constraints only exacerbating these problems. Traditional 'body-of-knowledge' guides simply prescribe acceleration - forcing project managers into a

panicked state of fast and furious decision-making. Structural complexities and uncertainties increase as desperate measures attempt to put the project back on schedule. All this coupled with the need to control, follow, and report on these same activities, the process soon falls apart.

Williams (2005) acknowledges that 'agile' or 'lean' methodologies, such as Scrum, attempt to address these problems. In particular, Agile does not place a heavy focus on upfront, forecasted planning, but rather allows the project details to 'emerge' with experience. Secondly, without a detailed plan, the project manager command and control the team, but must assume a participative and collaborative management style. Lastly, it becomes clear that planning is not a one-time event that takes place at the outset, but rather becomes a continuous activity in response to the unfolding project.

Williams' observations (2005), based upon an analysis of project overruns, suggest that Agile is a methodology that attempts to address complexity, uncertainty, and tight time-constraints - which can lead us to hypothesize that in doing so, Agile attempts to better counter these factors with the creative input of the project team.

1.2.2 PROJECT MANAGEMENT OFFICE vs. INNOVATIVE PROJECT OFFICE

At the organization level, there is also a need for lighter, more flexible structure. Duggal (2001) argues that PMO must evolve into lighter, faster, and more flexible structures that promote innovation. He argues that project offices must adapt to the chaotic, uncertain environments in which today's projects take place. Project management practices that focus on efficiency, control, and rigid repeatability have simply not proven themselves universally applicable.

Figure 1.6 presents Duggal's (2001) findings on the characteristics of a traditional PMO and how they need to change in order to achieve his "next generation", innovative PMO.

Duggal's (2001) research further support the interest and relevance of this research that explores the correlations between lighter, more 'agile' project management practices and the nourishment of creativity - the essential ingredient of innovation.

Figure 1.6 Traditional versus Next-Generation Project Management Office

(Duggal, 2001)

1.2.3 PROJECT AMBIDEXTERITY

Parmentier (2007) shows us that in highly creative, innovative, and high-technology environments it can be difficult to separate the 'exploration' business initiatives from those of 'exploitation'. In these situations, projects must often be 'ambidextrous' and fulfill both roles. This goes against traditional project

management which strictly requires that exploration be performed prior to project initialization and that projects remain vehicles of exploitation.

In traditional project management, the plan is the baseline upon which progress and success are measured. The plan is detailed, in terms of both functional requirements and implementation specifications, at the very beginning of the project. This means that there is no room during the execution of the project to explore new, creative functionalities or alternate implementations. Parmentier shows us that, in reality, industries such as the video-game industry cannot follow this traditional definition of project management.

1.2.4 ERICSSON'S PROPRIETARY PROJECT MANAGEMENT METHODOLOGY

Ericsson, a global telecommunications company, has spent 15 years evolving its proprietary project management methodology, which they call PROPS (Dinsmore, Cooke-Davies, 2006). With so many project management standards in the world, it is interesting to understand why a company would choose instead to develop their own system. Bergman (cited in Dinsmore & Cooke-Davies, 2006) explains that Ericsson was motivated, in part, by a desire to find more flexibility and adaptability in their project management practices, stating that "The demands for more efficient and flexible project management have increased, and new project types have emerged." By not accepting traditional prescriptions and instead developing their PROPS system, Ericsson was able to overcome some common shortcomings and leverage targeted benefits. For example, PROPS is a system that (Dinsmore & Cooke-Davies, 2006):

- Provides a "model [that] supports new ways of working and does not become an obstacle to introducing new techniques" (p.279)

- removes "roadblocks" while retaining what works well
- and makes project management everyone's responsibility, not just the project manager's

In summary, Ericsson's motivation to develop an adaptive project management system can be resumed in Bergman's following statement: "A rigid methodology that conserves old and inefficient ways of working may be more harmful to the company than no methodology at all." (Dinsmore & Cooke-Davies, 2006, p.280).

1.2.5 GROWTH AND INNOVATION

Shenhar and Dvir (2007) presents the need to reinvent project management in light of the unsatisfactory success rates we see when applying traditional project management methods alone. They stress the need for an "adaptive project management approach" (p.11) that addresses some of the important shortcomings of traditional methods. Table 1.1 summarizes the need for more adaptive planning, management, and connection to the project environment - in order to meet the complex needs of todays innovative projects.

Approach	Traditional project management	Adaptive project management
Project goal	Getting the job done on time, on budget, and within requirements	Getting business results, meeting multiple criteria.
Project Plan	A collection of activities that are executed as planned to meet the triple constraint	An organization and a process to achieve the expected goals and business results
Planning	Plan once at project initiation	Plan at outset and re-plan when needed

Approach	Traditional project management	Adaptive project management
Managerial approach	Rigid, focused on initial plan	Flexible, changing, adaptive
Project work	Predictable, certain, linear, simple	Unpredictable, uncertain, nonlinear, complex
Environment effect	Minimal, detached after the project is launched	Affects the project throughout its execution
Project control	Identify deviations from plan, and put things back on track	Identify changes in the environment, and adjust the plans accordingly
Distinction	All projects are the same	Projects differ
Management style	One size fits all	Adaptive approach, one size does not fit all

Table 1.1 From Traditional to Adaptive Project Management

(Shenhar & Dvir, 2007, p.11)

Shenhar and Dvir (2007) go on to propose a diamond classification model that can help project professionals identify and understand the four (4) critical characteristics of a project. Armed with this information, project managers are thought to be better able to adapt their project management approach appropriately. These four axes are novelty, technology, complexity, and pace. Table 1.2 provides more detail on the model's scales.

Axes	Scale
Novelty	- Derivative - Platform - Breakthrough
Technology	- Low-tech - Medium-tech - High-tech - Super-high-tech
Complexity	- Assembly - System - Array (system of systems)
Pace	- Regular - Fast/competitive - Time-critical - Blitz

Table 1.2 Distinctive Project Characteristics

(adapted from Shenhar & Dvir, 2007)

1.2.6 DIFFERENCES OF THE IT INDUSTRY

Similarly to Shenhar (2007), Dinsmore and Cooke-Davies (2006) propose their own multi-axes model for characterizing projects. The model is composed of ten axes, each scaled from one (1) to five (5). The axes are:

1. *Projectization*: The extent of project culture
2. *Leadership*: Organizational leadership
3. *Business*: Extent of business (versus technical) culture
4. *Multiprojects*: Multiproject management
5. *Systems*: Project management structure, methods, and systems
6. *Authorization*: Degree of authorization held by a project
7. *Information*: Centralization of project information for each project
8. *Team Type*: Ability to match project team to the needs of the development (stage and type)
9. *Project Management Capability*: Capability of project management staff
10. *Matrix*: Strength of project versus functional management

The reason for this classification model is to help identify and understand the differences between projects - and adapt traditional project management practices in consequence. Dinsmore and Cooke-Davis (2006) state that "Strong justification exists for the growing trend to adapt [traditional] project management practices to the different kinds of projects and to different industries..." (p.260).

Information technology projects are named as some of the most difficult projects to manage. Specifically, custom software development projects are described as "several orders of magnitude more difficult" (Dinsmore & Cooke-Davis, 2006 p.271). The most significant difference in this industry is the intangibleness of the product, making them difficult to scope - and by extension - the project itself difficult to scope.

The recommended 'upfront planning' in traditional project management therefore becomes challenging, if not largely futile.

Perhaps not surprisingly, the recommendations for managing such projects hint at an "agile" approach of 1) constant client involvement rather than management-by-plan, 2) requirements management as opposed to change management, 3) alternative estimating methods such as functional point analysis, and 4) a non-linear project life cycle such as spiral.

1.2.7 SUMMARY

This section presented the need for alternate, innovative project management approaches. Even though traditional systems have much merit and are appropriate for some projects, there remains a need for lighter, more flexible and adaptive methodologies. Traditional systems do not seem to work as well in environments of high uncertainty, new technology, and tight time constraints (Dinsmore & Cooke Davies, 2006; Duggal, 2001; Parmentier, 2007; Shenhar and Dvir, 2007; Williams, 2005). As such, project practitioners find themselves not only seeking innovation in what they deliver from projects, but equally in how they manage those projects. These findings confirm the need for this research study.

1.3 AGILE AS AN INNOVATIVE PROJECT MANAGEMENT METHOD

This section details Agile project management as an innovative movement in project management. In response to the shortcomings of traditional project management presented above, Agile project management prescribes its own set of practices in an attempt to achieve better results in software development and new product development projects. This chapter also describes the parallels between Agile project management practices and creativity as a factor of innovation. As such, the conceptual framework of this research begins to take shape.

1.3.1 THE NEW NEW PRODUCT DEVELOPMENT GAME

Takeuchi and Nonaka's (1986) "The new new product development" has been cited as the origin of Agile project management (DeGrace, 1990; Schwaber, 2004). In reviewing this work, it quickly becomes clear where the term "Scrum" comes from. Takeuchi and Nonaka (1986) present a metaphor comparing traditional, linear project management process to that of a relay-race, and propose a new, parallel, multi-disciplinary process liken to that of rugby. A popular image of rugby is that of the scrum - where the teams huddle, arms linked, in a joined force to push the other and capture the ball. Their concept lead them to propose a new definition of project management - placing all focus on "agility", and characterized by the following:

1. *Built-in instability*: The project has a vision and support, but no detailed specifications.
2. *Self-organizing project teams*: The team manages uncertainty by being empowered with autonomy, self-transcendence, and cross-fertilization; taking initiatives and risks.
3. *Overlapping development phases*: Phases overlap to achieve continuous coordination and integration.

4. *Multilearning*: Multidisciplinary project teams learn at multiple levels (individual, team, organization) as well as in multiple functions (across the various disciplines involved in the final product).
5. *Subtle control*: Management's job is to prevent chaos, but to allow sufficient freedom so as not to impede creativity and spontaneity. Teams self-manage.
6. *Transfer of learning*: Key individuals are reassigned to subsequent projects to proliferate the learning process.

Takeuchi and Nonaka (1986) also present some important limitations to their findings - that are not explicitly identified in the modern Agile model. They include: (1) it requires exceeding amounts of overtime, (2) may not apply to breakthrough projects, (3) may not apply to large projects, (4) may not apply to projects "masterminded" by a limited set of exceedingly capable individuals.

Finally, several important managerial implications are enumerated. The new, proposed process requires a change in management style. Responsibility and learning have to be shared at all levels and among all team members, and new product development projects have to be seen not only as a sources of product innovation, but also as sources of organization innovation.

These ideas have been carried forward into the modern day Agile project management practices, particularly in the work of Ken Schwaber (2004) that we will discuss in chapter three.

1.3.2 AGILE MANIFESTO

In February 2001, seventeen leading minds in software development calling themselves "The Agile Alliance" put their minds together looking for "an alternative to documentation driven, heavyweight software development processes" [3]. The result was a written philosophy called the "Manifesto for Agile Software Development" [1]. In essence, they suggested some dramatic changes (if not improvements) in the two principle functions of their business:

1. Software engineering practices
2. Project management practices

The Agile manifesto attempts to address the traditional project management practices that proved to be the most harmful or counter-productive during a software development project. By identifying these weaknesses, the manifesto is then able to propose alternate, remedial practices to improve the process. Among the weaknesses identified in traditional project management were: focusing on the plan rather than on the needs, blocking changes, all-or-nothing project delivery, communication via documents, and rigid, predefined processes. Table 1.3 below summarizes the comparison.

[3] Agile Alliance (www.agilemanifesto.org) accessed 21-Oct-2008

Agile Project Management Principle [3] (Agile Alliance, 2001)	**Traditional Counterpart** (PMI, 2008)
Our highest priority is to satisfy the customer through early and continuous delivery of valuable software.	Highest priority of following the plan.
Welcome changing requirements, even late in development. Agile processes harness change for the customer's competitive advantage.	Minimize change.
Deliver working software frequently, from a couple of weeks to a couple of months, with a preference to the shorter timescale.	Deliver at the end of the project ("Waterfall" approach)
Business people and developers must work together daily throughout the project.	Business people and developers communicate through a plan.
Build projects around motivated individuals. Give them the environment and support they need, and trust them to get the job done.	People are resources who are assigned to predefined tasks.
The most efficient and effective method of conveying information to and within a development team is face-to-face conversation.	Communication is primarily managed through documentation.
Working software is the primary measure of progress.	Conformance to the plan is the measure of progress.
Agile processes promote sustainable development. The sponsors, developers, and users should be able to maintain a constant pace indefinitely.	Maximize resource output at all times.
Continuous attention to technical excellence and good design enhances agility.	Design and quality guidelines are defined before project execution.
Simplicity - the art of maximizing the amount of work not done - is essential.	Follow predefined process and procedures.
The best architectures, requirements, and designs emerge from self-organizing teams.	Architecture, requirements, and design are provided to the teams. Teams are highly managed.
At regular intervals, the team reflects on how to become more effective, then tunes and adjusts its behavior accordingly.	Project postmortem provides a mean of reflection and improvement.

Table 1.3 Agile versus Traditional Project Management Philosophies

1.3.3 SCRUM ORIGINS AND DISTINCTION

Abrahamsson (2003) provides us with an excellent analysis of the many developments methods that fall under the Agile umbrella. In figure 1.7 we see a timeline of when the various models came to be. The first models appear around 1986 with Lantz's Prototyping methodology, Boehm's Spiral model, Gilb's Evolutionary life-cycle, and Takeuchi and Nonaka's New product development game. The most significant models to contribute to the Agile Manifesto (Agile Alliance, 2001) are the Crystal family of methodologies (Cockburn, 2001), Adaptive Software Development (ASD) (Highsmith, 2000), Extreme Programming (XP) (Beck, 1999), Pragmatic Programming (PP) (Hunt and Thomas, 2000), and Scrum Development Process (Schwaber, 1995, Schwaber and Beedle, 2001). All these models uphold the Agile philosophy of being: Iterative and incremental, delivering working software quickly and frequently; cooperative between customer and development team; straightforward, following a simple process and minimal documentation; and adaptive to changes in specifications and deliverables.

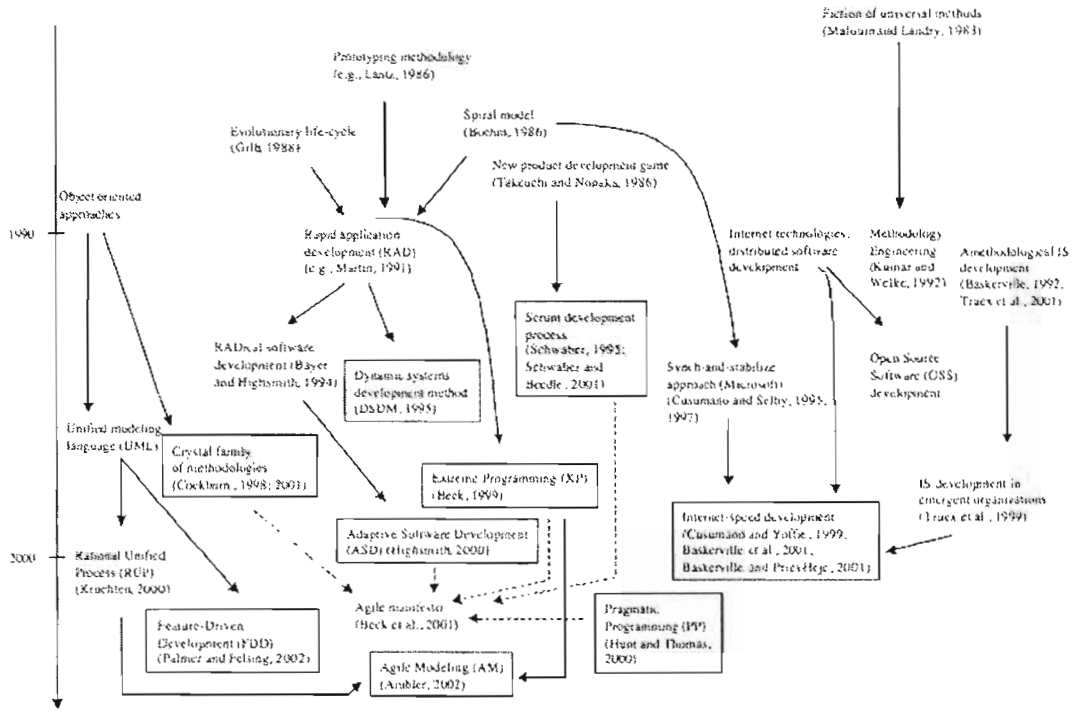


Figure 1.7 Evolutionary Map of Agile Methods

Abrahamsson (2003, p.3)

Abrahamsson (2003) goes on to state that Scrum is one of the strongest models in its support for project management functions. In fact, he states that Scrum is "explicitly intended for the purpose of managing... projects." (p.5). Figure 1.7 puts Scrum in opposition to other Agile approaches that either add or exclusively prescribe software engineering practices:

- ASD: Adaptive Software Development
- AM: Agile Modeling
- Crystal: Crystal family
- DSDM: Dynamic Systems Development Method
- XP: Extreme Programming
- FDD: Feature-Driven Development
- ISD: Internet-Speed Development

- PP: Pragmatic-Programming

By avoiding tight coupling with any specific engineering practices, Scrum achieves a highly independent project management method that can remain relevant in a large range of project situations. Nonetheless, Scrum does acknowledge a software development life-cycle through which the project should pass, as opposed to the Internet-Speed Development (Cusumano and Yoffie, 1999; Baskerville et al., 2001; Baskerville and Pries-Heje, 2001) approach that is most similar to Scrum in its focus on management rather than engineering processes. It is also importantly noted that Scrum provides concrete guidance in its methods, even though many Agile models prescribe only abstract principles. Scrum is further defined to be self-adjusting to the particular needs of the project environment in which it is applied - whereas most traditional project management models, and some Agile models, are "universally predefined" whereby they claim to be turn-key solutions that need not and should not be altered. Finally, Abrahamsson (2003) cites the work of Rising and Janoff (2000) as an example of empirical research evidence supporting the merits of Scrum methods.

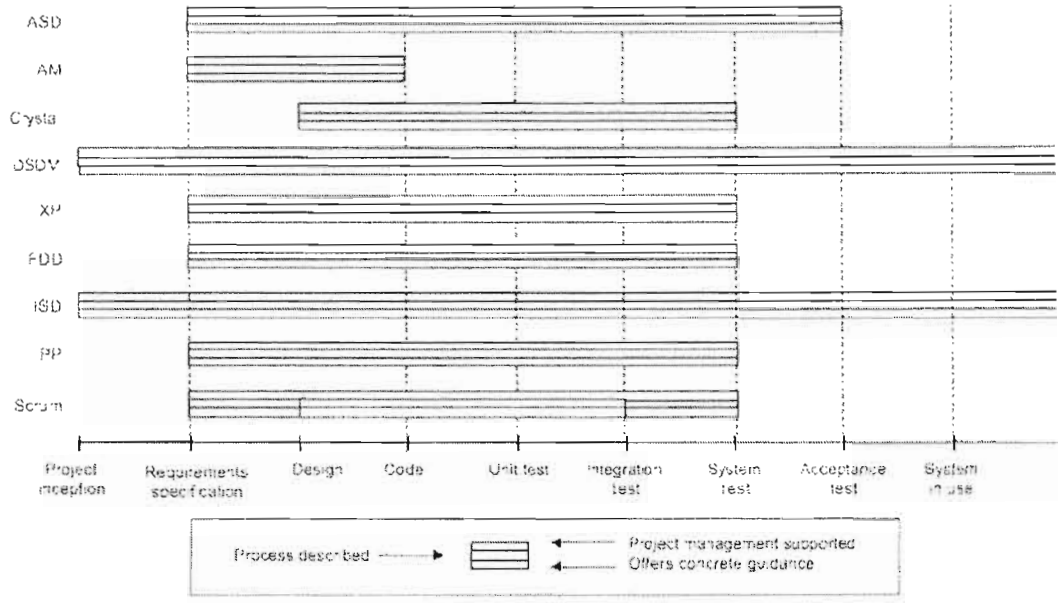


Figure 1.8 Comparing Agile Methods

Abrahamsson (2003, p.5)

Abrahamsson's literature is useful to this research project for its support of Scrum as a project management intensive method. Similarly, Scrum is the only such method to qualify as both 'situation appropriate' - by being adaptable to the particular project environment - and based on 'empirical evidence' (Abrahamsson: Rising and Janoff, 2000). Therefore, Abrahamsson's findings support the premise of this research that Scrum provides a valid measure of Agile project management practices in the workplace.

1.3.4 AGILE PROJECT MANAGEMENT WITH SCRUM

Scrum (Schwaber, 2004) is a project management methodology that is built upon the Agile principles. Scrum is significantly different from traditional project management methods and thus can requires much adaptation for newcomers. In

addition to requiring the cultural adoption of Agile principles, Scrum also employs its own vocabulary. The following paragraphs describe Scrum's major characteristics.

1.3.4.1 ROLES IN SCRUM

Scrum describes three roles that constitute the project team; the Product Owner, the Scrum Master, and the Team Members.

The *Product Owner* is the person ultimately responsible for delivering business value from the project. The *Scrum Master* - the person responsible for ensuring that the project unfolds as efficiently and effectively as possible, and ensures that the Agile principles are upheld. The Scrum Master must ensure that the product backlog is up-to-date and in a healthy state, that the Product Owner fulfills his duties to the project, and that the team has a working environment that is conducive to the most effective and efficient delivery of business value. This can mean resolving problems that the team has with tools, infrastructure, or resources. This can mean keeping interferences and distractions to a minimum. It can also mean fighting political battles that threaten the health of the project.

The *Team Members* form a multi-disciplinary team(s) consisting of 5 to 9 members. Collectively, the members are responsible for delivering the product features - completely, and incrementally - and ultimately delivering the intended business value.

1.3.4.2 SCRUM ITERATIONS

In Scrum, the project unfolds as a series of incremental iterations called 'Sprints'. Each sprint is ideally between 2 and 4 weeks in duration. At the end of each sprint, the team must deliver "Potentially Shippable" product features (Schwaber, 2004). This means that the features are ready to be delivered to intended end-users and, as such, the features are ready to deliver their ultimate business value.

1.3.4.3 ARTIFACTS IN SCRUM

Scrum implements the following project artifacts:

Product Backlog - A prioritized list of features that the Product Owner wishes to see in the product. This obviously assumes that the project deliverable can be divided into independent features, providing some business values in and of themselves. Technical specifications are intentionally omitted unless they impose particular constraints.

Sprint Backlog - The list of features from the top of the Product Backlog that the team commits to delivering in the current Sprint.

Release Burn-down Chart - provides a graphical representation of the progress towards a completed release. A release is an iteration or group of iterations after which the Product Owner would like the completed features to be delivered for actual use. A release typically equates to a version of the product. Release progress is measured in delivered features only. The philosophy is to keep everyone's focus on the business value delivered. This is in contrast with traditional progress reporting that tracks time and schedule expenditures in relation to the plan.

Sprint Burn-Down Chart - provides a graphical representation of the progress towards a completed Sprint. Progress is measured in days remaining only. This is drastically different from traditional project management practices like "Earned Value" that tracks tasks form their original estimates, the work completed, and the work remaining (PMI, 2008). Under the Scrum philosophy, only time remaining is followed. One reason is that Scrum's philosophy suggests that meticulous time

tracking turns project management into a reporting relationship, removing the team's focus from delivering business value.

1.3.4.4 COMMUNICATION IN SCRUM

Scrum favors face-to-face, oral communication, in a full-team setting, above all other types of communication.

The *Product Backlog Maintenance Meeting* occurs at the very beginning of the project, and at regular intervals, often weekly, throughout the life of the project. The goal of this meeting is to keep the product backlog up to date and understood. Project features are listed, prioritized (ranked) and clarified. Changes to the product backlog are discussed to identify dependencies, constraints, and clarity.

The *Release Planning Meeting* is held to plan the set of features that the Product Owner would like included in a release. Even though the features delivered after every sprint are required to be 'potentially shippable', the Product Owner may or may not decide to release said features at that time. In the case where an official release requires additional overhead, it may be desirable to plan releases after a number of iterations. The release planning is typically held as part of the Product Backlog Meeting, where features are sufficiently detailed to understand the interrelations between features and thus logical groupings that could make up a release.

The *Sprint Planning Meeting* occurs at the beginning of each sprint. During this meeting, the project team selects and details the features it will deliver. The team selects features starting from the the top of the product backlog list (therefore the features with the highest priority), detailing the implementation of each in sufficient detail (in hours of work) to be able to confidently commit to their delivery.

The *Daily Scrum Meeting* is a 15 minute meeting that occurs every morning. Typically, it is a quick 'standing' meeting, where each team member is answers the three following questions:

1- What they accomplished the day before?

2- What they plan to accomplish today?

3- What they needed to improve their efficiency and effectiveness? (remove blockers, problems, missing expertise, etc..)

The *Sprint Demonstration Meeting* occurs on the last day of every sprint. The team demonstrates the features that they completed during the iteration. The Product Owner gets to see, and take possession, of said features. The client can choose to accept or refuse the features. This information enables the client (product owner) to re-prioritize and adjust the project requirements. Finally, this meeting acts as a stage-gate, at which time the client chooses whether or not, or how, to continue the project.

The *Sprint Review Meeting* also occurs at the end of the sprint, and gives the team an opportunity for retrospection and reflexion on the project. They may choose to change membership, change processes, or even recommend a change in Product Owner.

1.3.4.5 THE SCRUM PROCESS

The Scrum process unfolds as follows. The first step is to create the value-prioritized list of desired features and functionalities of the Product Backlog. The project team then provides high-level estimates for the magnitude of effort required to deliver each item. Based upon these estimates an initial project charter is defined to estimate how long it will take to deliver the project as initially defined.

Drawing from the top of the product backlog, the team plans their first sprint. Features are detailed to the task level, which are then estimated in hours. The team decides what its capacity is for the coming weeks, and once that capacity is filled with task allocations, the planning is finished, and the sprint begins. This list of features and tasks, that are promised to be delivered, becomes the sprint backlog.

The sprint of the decided length (normally 2 to 4 weeks in length (Schwaber, 2004)) begins as each team member chooses a task and begins work. Everyday, each team member updates the remaining estimate of time to complete the tasks, and thus a sprint burn-down report can be produced and monitored.

The daily Scrum is a short meeting (typically 15 minutes (Schwaber, 2004)) where all team members report to the team (not the project manager) what they had accomplished the day before, what they would do that day, and what help they needed or impediments they needed removed. This daily, informal communication is the essence of Scrum (Agile Alliance, 2001; Schwaber, 2004).

Once or twice during the sprint the team holds a product backlog maintenance meeting, where they review the product backlog and make sure it is in good health. They see is the product owner or client have added, removed, or re-prioritized features. They break-down and provide more granular order-of-magnitude estimates for features that are very large or ambiguous. They may also update and review the estimates and potential implementations of the top priority features in preparation for the following sprint planning meeting.

At the end of the sprint, the team holds a sprint demonstration meeting where they present the deliverables they accomplished in the sprint. The Product Owner can chose to accept of reject these deliverables. Should they be rejected, they return to the backlog for future work. The Product Owner also decides whether or not the project is going well, and can chose to make changes or even stop the project.

Finally, the team ends each sprint with a retrospective meeting. Here, the team review their execution of the Scrum process and identify improvements that they would like to apply to subsequent sprints. This process of "inspect and adapt" is a key activity of continuous improvement of processes. Figure 1.9 provides a visual representation of the Scrum process.

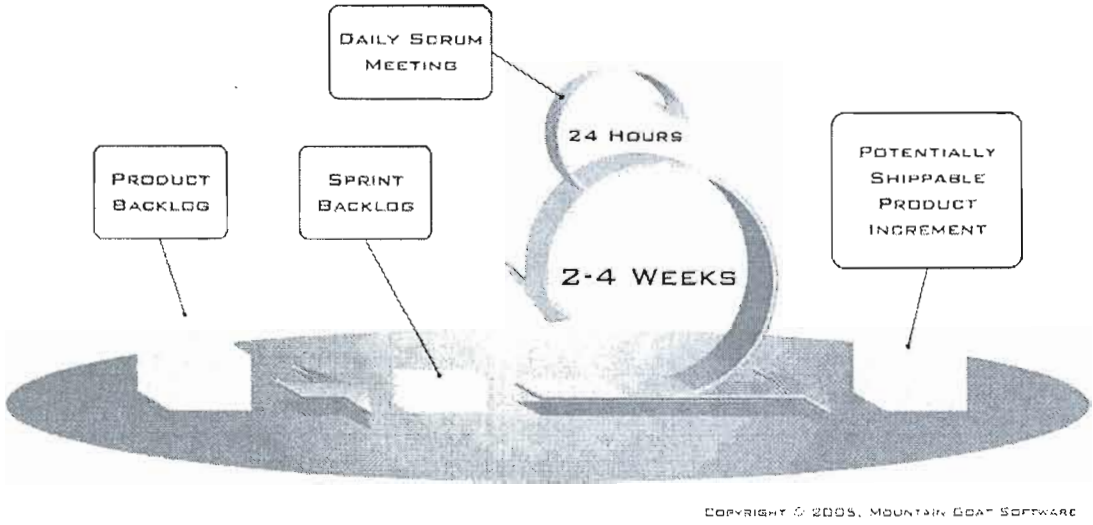


Figure 1.9 The Scrum Process

(Mountain Goat Software, 2005)

1.3.5 ENTERPRISE SCRUM

Published in 2007, Ken Schwaber's second contribution to the Scrum framework is entitled "The Enterprise and Scrum". This second work describes a framework for scaling Scrum to the organizational level. The new features of the model are presented below.

The first addition that is made to the single-project, single-team perspective of the original Scrum framework is the concept of teams forming *Scrums of Scrums*. This model recognizes that project teams cannot be limited to 5 to 9 people, as is described in the single-project perspective of Schwaber's earlier book (2004). Therefore, larger projects form multiple Scrum teams, respecting the limit of nine members each, and then members of each Scrum team subsequently assemble into a Scrum of Scrums team. The purpose of this team is to escalate the issues overflowing from each Scrum team up the project ladder. According to this model, Scrum can be scaled to a project of any size, and furthermore, to all levels of an organization. Figure 1.10 shows the scaling strategy within a single, large project.

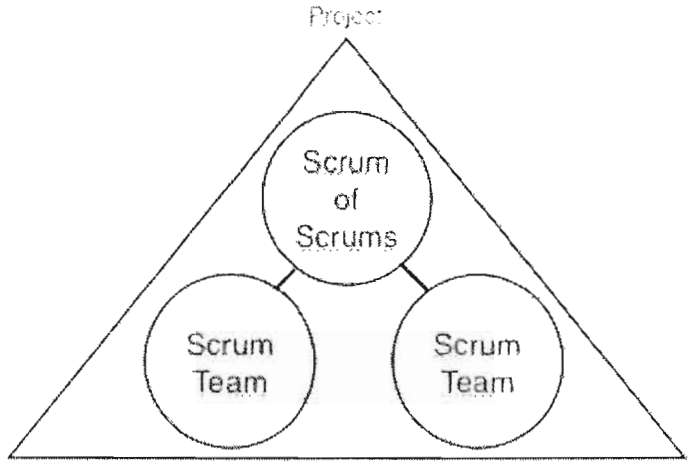


Figure 1.10 Scrum of Scrums Team

Schwaber (2007) continues scaling the model all the way up the organization - with a few additions. Three new management teams are added to better mirror a traditional staffing model - namely the Enterprise Transition Committee, the Scrum Rollout Teams, and the Scrum Center. We discuss them in more detail below. Figure 1.11 shows us the whole model of Enterprise Scrum.

The *Enterprise Transition Committee* (ETC) is the highest structure in the Scrum model, and equates to the highest levels of management in the organization. The ETC is essentially a project team, a Scrum team in itself, and executes it's mission in iterative, incremental Sprints. It's mission is akin to that of project portfolio management, commonly defined as the responsibility to "...maximize the value of the portfolio by careful examination of candidate projects and programs for inclusion in the portfolio and the timely exclusion of projects not meeting the portfolio's strategic objectives" (PMI, 2008).

The *Scrum Rollout Teams* are formed to proliferate the ETC's efforts throughout the organization. In general, these teams are responsible for removing impediments that prevent the project teams from achieving their full productivity.

The *Scrum Center* roughly equates to a Project Office, meant to provide support to projects. The PMI (2004) defines a Project (Management) Office as "...an organizational unit to centralize and
coordinate the management of projects under its domain" (PMI, 2008). The Scrum Center has the responsibility of training, coaching, mentoring, and auditing project teams. It is suggested that this office be staffed by experiences Scrum Masters from within and without the organization.

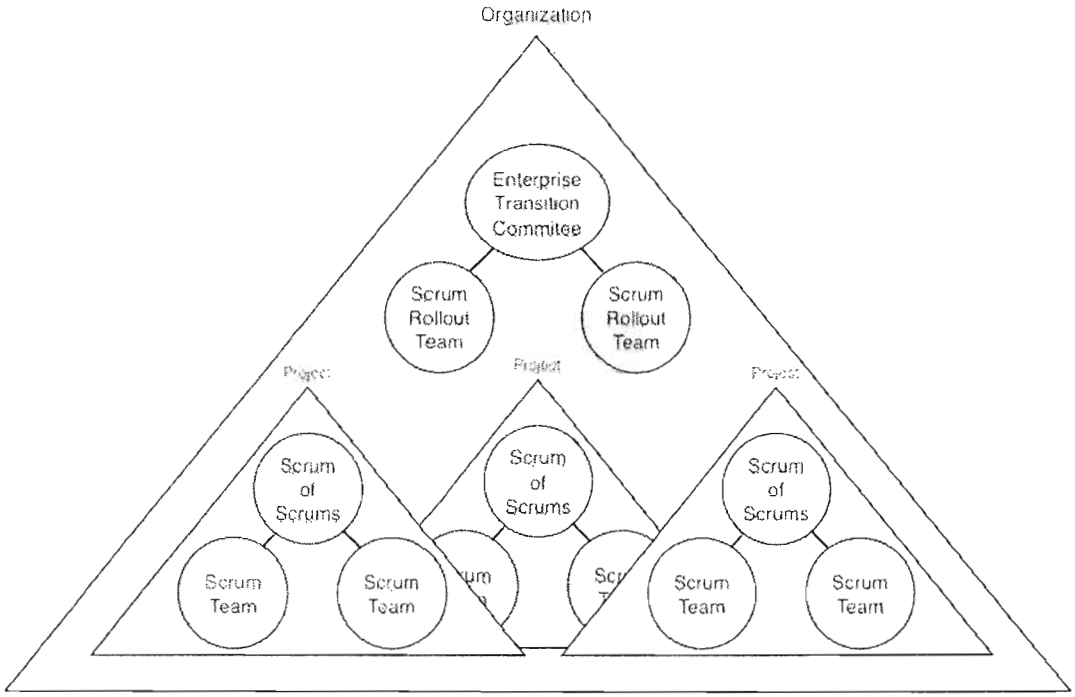


Figure 1.11 The Enterprise Scrum Structure

1.3.6 COMPLEX ADAPTIVE SYSTEMS

Augustine (2005) presents Agile project management under the model of a Complex Adaptive System (CAS). CAS systems are described as nonlinear, open, and dynamic. To manage such systems, project management practices need to be informal - being changes, added, and removed as the project team sees fit. Processes are seen simply as tools; to be used only as long as they remain useful, and are otherwise replaced.

His research identifies the following practices as the most salient of Agile project management in accordance with Complex Adaptive Systems:

- A guiding vision
- Organic teams of 7 to 9
- Simple rules
- Free and open access to information
- Light touch management style
- Adaptive leadership
- Leadership / collaboration model

Augustine (2005) also elaborates on the leadership style that conform best with Agile project management, what he refers to as "Leadership-Collaboration". He theorizes that collaborative leadership is one of the most salient practices in the Agile framework. As the name suggests, this project leadership style asks the project manager to participate and collaborate with the team members, in contract to the "command and control" style stereotyped of traditional project managers.

The commonalities that Augustine (2005) finds between Agile project management practices and Complex Adaptive Systems are also the significant differences between Agile practices and traditional project management practices. As such, Augustine's

findings (2005) further support our conceptual model that names Agile as a potential alternate project management model when considering complex projects.

1.3.7 SUMMARY

In this section we have explored Agile as an innovative project management methodology that aims to address and overcome the shortcoming of traditional project management - particularly as they apply to software development and the information technology industry. Agile offers a significantly different perspective to project roles, documentation and artifacts, plans and planning, communication, and project execution.

We will hypothesize, in later sections, that the reason why Agile methods are attractive in these situations is that they foster a needed creative environment and cater to the high levels of uncertainty inherent in these innovation projects.

1.4 EMPIRICAL EVIDENCE OF AGILE'S MERITS

In this section we will review current literature supporting the merits of Agile project management. We will see how particular Agile practices are found to contribute to as improved project process, and potentially to project success. What will become clear, however, is that there is little to no evidence as to why these practices work well in these environments. This lack of clear evidence is the central motivation of this research effort.

1.4.1 AGILE WITHIN A STAGE-GATE PROCESS

Karlstrom (2005) identifies some key practices of Agile project management that impact the traditional project management practice of stage-gates. As described by Cooper (1997), a stage-gate process involves placing evaluation milestones at various points in a project's life-cycle. At these "Go/Kill" milestones, projects are reevaluated against predefined business criteria - often strategic or financial. At these decisive moments, management decides whether to continue, accelerate, slow, kill, or re-prioritize a project. Resources may also be reallocated in light of these decisions. Similarly, the Standard for Portfolio Management (PMI, 2006) defines these "phase gates" as "decision points for 'go/no go' control decisions for projects, programs, and portfolios". Three prominent, global software development companies took part in Karlstrom's study: ABB Automation, Ericsson Microwave Systems, and the Vodafone Group.

In his results, Karlstrom (2005) found that Agile practices had many positive impacts on the stage-gate process - summarized in figure 1.12. Firstly, planning in Agile projects involves high-level upfront planning, usually at the feature or functionality level. These features are prioritized based on the value they will return. Detailed

planning is then performed at the 'sprint' level - a two to four week execution period where the highest priority items are delivered. Lastly, micro-planning and adjusting due to experience gained during execution is performed daily. Karlstrom (2005) found that these practices brought about the following improvements, among other, to the traditional stage-gate process : early feedback from clients, avoidance of requirements' cramming, and a flexibility in plans and planning.

Communication and follow-up in Agile projects were found to have the most significant impacts on the stage-gate process. Karlstrom identifies improved team communication, better management of changes, and team empowerment as key results.

Agile's iterative and incremental process, combined with simplified roles, led to continuous feedback from clients coupled with ongoing clarification and prioritization - a winning combination.

Finally, the collaborative, supportive, and participative project management style gave way to heightened motivation from the team, better focus on the deliverables rather than a plan, and little resistance to change.

Findings summary for the effects of agile methods in three industry cases

Area	Agile feature	Effect*
Planning and prioritization	Most important feature first	+ Early feedback on features + No delays of important features
	Micro planning	+ Avoidance of requirements' creamming + Fixed plans avoided ! Little support for long-term plans
Communication and follow-up	Coherent teams	+ Good internal communication ! Potential isolation of agile team
	Automatic testing	+ Means for communication of change + Higher quality
	Small, manageable tasks	+ Feeling of being in control
	Continuous integration	+ Higher quality + Progress measure for management
Process model and roles	Customer involvement	+ Continuous feedback + Relevant features + Technical product manager is a good candidate as customer representative
	Documentation as tasks	+ Priorities resolved between documentation and code ! Conflicts visible between different amounts of documentation
Project management	Engineering-level empowerment	+ Engineers feel motivated ! Managers afraid initially ! Management training needed
	Focus	+ Engineers focus on past and current release, managers on current and future release + (!) Technical issues raised (too) early for management
	Engineering-level initiative	+ Little resistance to change

Figure 1.12 Agile with Stage-gate

(Karlstrom, 2005, p.46)

In summary, we note the parallels between these positive impacts and the elements of a work environment that are key to enabling creativity. Such benefits as better communication with and from the client, greater freedom and empowerment of the project team, better focus on learning and deliverables, and a collaborative management style all parallel the requirements for a work environment where creativity can flourish, and thus, where innovation can be achieved.

1.4.2 SALIENT AGILE PROCESSES

Agile prescribes a multitude of practices, but projects team that call themselves Agile may or may not apply all all of them. Baskerville's research (2006) identifies the six most commonly implemented Agile practices found across his ten

case studies. Through a grounded-theory approach, he also identifies the most common advantages and disadvantages resulting from these practices. A summary is provided in table 1.4 below.

Common Agile Practices (Baskerville, 2006)	Advantage / Disadvantage
Parallel development and frequent releases	Advantages: Relieving time-to-market compression, faithfully and rapidly fullfill most market expectations, responsive and adaptive to new features,
	Disadvantages: User confusion with frequently changing feature set, high training requirements, can lead to excessive change requests, necessitates breaking the product into independent features, small deliveries can be difficult to scale, high overhead of releases.
Tools and reusable components	Advantages: allows for less experienced members, implicit architecture provided, lower costs, higher quality.
	Disadvantages: creates strong third-party dependencies, latent problems in tools can be difficult to identify and resolve, expertise is replaced by automation.
Product Prototyping	Advantages: crystalizes requirements, reveals design issues, promotes user involvement, production (coding) begins right away.
	Disadvantages: can be costly in rework, overemphasis on user-interface, security, scalability, and robustness are difficult to prototype.
Customer implantation	Advantages: refine requirements directly with customer, manage uncertainty with constant collaboration, rapid face-to-face communication enables rapid response, collaboration promotes engagement and commitment.
	Disadvantages: Customer not able or willing to be implanted, communication barrier as customer is not technical, customer pushes tangible features before intangibles like quality, reusability, scalability, and infrastructure.

Common Agile Practices (Baskerville, 2006)	Advantage / Disadvantage
Multitiered architecture	Advantages: flexibility, loose-coupling, reduced complexity by separating concerns, scalability, portability, easy rework of components.
	Disadvantages: difficult and costly to optimize, potential duplication, complexity of integration (more numerous, small parts).
Tailored methodology	Advantages: absorb change more readily, process adapted to people and product, reduce unnecessary overhead if synergy exists.
	Disadvantages: increased overhead from lack of standardization, difficulty in synchronizing across multiple teams, lack of consistency, lack of process learning (repeat mistakes, do not repeat successes),

Table 1.4 Common Agile Practices and their Impacts

(adapted from Baskerville, 2006)

Baskerville (2006) validates that many of the Agile practices do result in their desired benefits. Iterative development relieves time crunches and maintains as openness to change, early delivery of working software crystalizes specifications, client involvement improves clarity and decision-making responsiveness. These results are encouraging as they support the conceptual framework of this project. Nonetheless, Baskerville's results are descriptive, and do not offer any level of measurement. This further supports the need for our empirical and quantitative approach.

1.4.3 MANAGEMENT CHALLENGES

Boehm (2005) identifies eight salient practices of Agile - (1) embrace change, (2) frequent delivery, (3) simple design, (4) refactoring, (5) pair-programming, (6) retrospective and reflexion, (7) tacit knowledge, and (8) test-driven development -

and found the following key challenges when transitioning from traditional project environments to Agile:

- Resource loading, slack, timekeeping, capital evaluation
- Required colocation, customer access
- Nonfunctional requirements
- Documentation
- Critical design reviews (milestones)
- Contractual and source selection issues
- Interfacing/integration with other methodologies/disciplines
- Predictability, perfect knowledge
- Statutory/regulatory constraints
- HR policies and processes
- System interface control
- Roles, responsibilities, and skills
- Agile work on legacy systems
- Formal requirements
- System engineering V-process model
- Maturity assessments
- Traditional engineering measurements
- Cost estimation

Data was collected at the 2004 fourth annual University of Southern California Center for Software Engineering (USC-CSE) Affiliates Annual Research Review. Participants included agile developers, traditional aerospace and telecommunications developers, agile method creators, and academics.

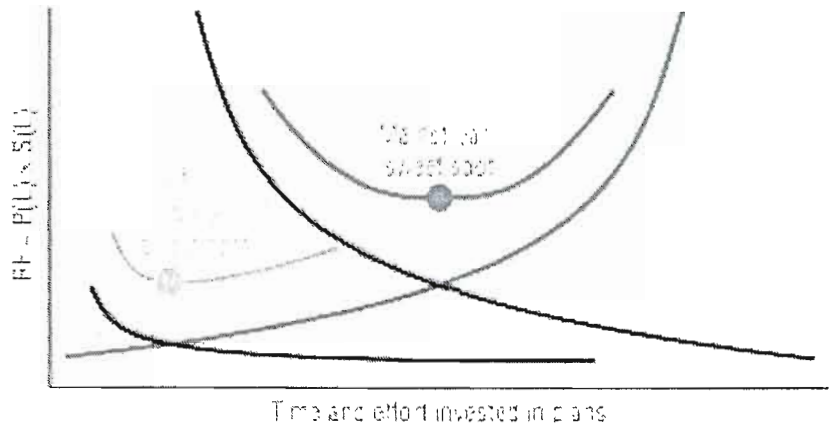
These results tell us that indeed Agile methods work, even though they do present some challenges. Unfortunately, the results do not suggest why or how Agile proves

to be effective. We are given no tools, no measures with which to study Agile's merits. This shortcoming further supports the need for our study.

1.4.4 AGILE 'SWEET SPOT'

Boehm (2002) analyses project management methods from a 'risk exposure' point of view. Measured by the probability of financial losses (P(L)) due to inadequate project management practices, multiplied by probable size of the losses (S(L)), Boehm (2002) charts his interpretation of both traditional and Agile project management curves - as seen in figure 1.13 below. The line curving from bottom-left to top-right represents the variation in effort a company can spend on planning over time. The line curving from top-left to bottom-right represents the risk exposure introduced by the varying efforts in planning. Therefore, the left of the graph represents little effort in planning that results in high risk of omissions and oversights. To the right, we spend much time planning, in the hope of "planning away" such risk. However, the cost of planning is high, and there are no guarantees that there will be a return on that investment.

Figure 1,13 graphs the model. The independent variable in his model is the amount of time spent on planning. The argument in the traditional model is that plans create control, and are thus encouraged. However, this can only be true if the requirements are known early and highly stable. The Agile method argues that developing and attempting to follow detailed plans is inappropriate when project requirements are largely emergent and rapidly changing, and as such will result in major risk of losses.



RE=Risk Exposure, P(L)=Probability of Loss, S(L)=Size of Loss

Figure 1.13 Agile Sweet-Spot

Boehm (2002, p.67)

Our research hypothesizes upon Boehm's (2002) results. He states that Agile project management is best suited for environments where requirements are emergent and rapidly changing. It can be argued that such environments require creative problem-solving and solution to respond to shifting requirements. Therefore, we hypothesize a correlation between the use of Agile methods and work environments that fosters creativity.

1.4.5 AGILE AND CULTURAL FIT

Berger (2007) shares his case study providing empirical evidence that Agile project management (APM) cannot be implemented under any organizational culture. The highly prevalent 'blame culture' of the bureaucracy was in strict opposition to the collaborative environment necessary for successful Agile implementation. The information technology project undertaken in the case showed many of the 'text-

book' characteristics of a prime candidate for APM practices, namely high levels of uncertainty and frequently changing requirements. Furthermore, the APM implementation seemed to follow the industry best-practices of co-location, short, iterative development cycles, stakeholder involvement, and workshop requirements gathering. Unfortunately, all this was not enough, and the lack of cultural-fit proved more an immovable obstacle to the APM process.

The ever present blame culture prevented the project team from achieving true team-work, collaboration, rapid decision-making, and collective commitment and ownership; all key requisites of APM. Prioritization of development features is the key to the planning, scope control, cost control, and time-boxing that is the essence of APM. The inability of business owners to achieve consensus was an immediate road-block to the APM process. Berger (2007) even noted that many people, having never been given the authority to make decisions in the bureaucracy before, were unable to make decisions even after been told to do so. They seemed unable to undo the paralyzing culture they had grown so accustomed to.

This article accentuates the cultural characteristics of a Agile project management environment, and their sharp contrast to bureaucracies. Similarly, we note that many of the elements that place the bureaucracy in opposition for Agile are also in opposition to many of the prerequisites of a creative work environment (Amabile, 1996). These finding therefore support the hypothesis that perhaps there may be correlations between APM and a creative work environments.

1.4.6 SUMMARY

This section has presented evidence to the merits of Agile as an alternative project management methodology. In real-world applications, many authors (Baskerville, 2006; Berger, 2007; Boehm, 2002, 2005; Karlstrom, 2005) have seen

favorable results from Agile methods. Many such results are consistent with the original intent of the Agile founders, such as continuous client feedback, rolling planning, early and frequent delivery of business value, improved communication, and adapting to change. Unfortunately, what is missing from this literature are measures and quantitative results that would make it possible to not only confirm these findings, but also enable us to progress towards theories in project management. This weakness in the literature is a central motivation of this research project.

In the next section we will present the literature on KEYS for creativity (Amabile, 1996), the tool we employ to measure creativity in the workplace.

1.5 CREATIVITY AS A FACTOR OF INNOVATION

We subscribe to the following definitions of creativity: "Creativity is a mental and social process involving the generation of new ideas or concepts."[4]. Furthermore, from a scientific standpoint, creative ideas should have both an element of originality and some practical appropriateness [4]. Lastly, creativity is thought to be "...an essential part of innovation and invention and is important in professions such as business..." [4].

Creativity is often associated with innovation - or the successful application of an incremental, radical, or revolutionary change in thinking, products, processes, or organizations [4].

This research project is interested in the potential relationship between Agile project management practices, creativity in the workplace, and ultimately innovation-reliant projects.

1.5.1 KEYS: ASSESSING THE CLIMATE FOR CREATIVITY

Amabile (1996) developed the KEYS system to measure the creativity perceived in the workplace. The tool originates from earlier studies in the late 1980s, has gone through several revisions, and was formerly named the Work Environment Scale. The KEYS systems continues to be one of the most respected tools in the industry (Mathisen, 2004).

In her research, Amabile (1996) found that creativity in the workplace was an important source of innovation in a companies products and services. She identifies eight groups of characteristics of the workplace that contribute to creativity in a significant way: supervisory encouragement, challenging work, work group supports, freedom, controlled workload pressure, organizational encouragement, sufficient

[4] http://www.wikipedia.org accessed February 15, 2009

resources, and the removal of organizational impediments (see figure 1.14 below). These eight determinants, and their composition, are discussed in more detail in the conceptual framework of chapter three.

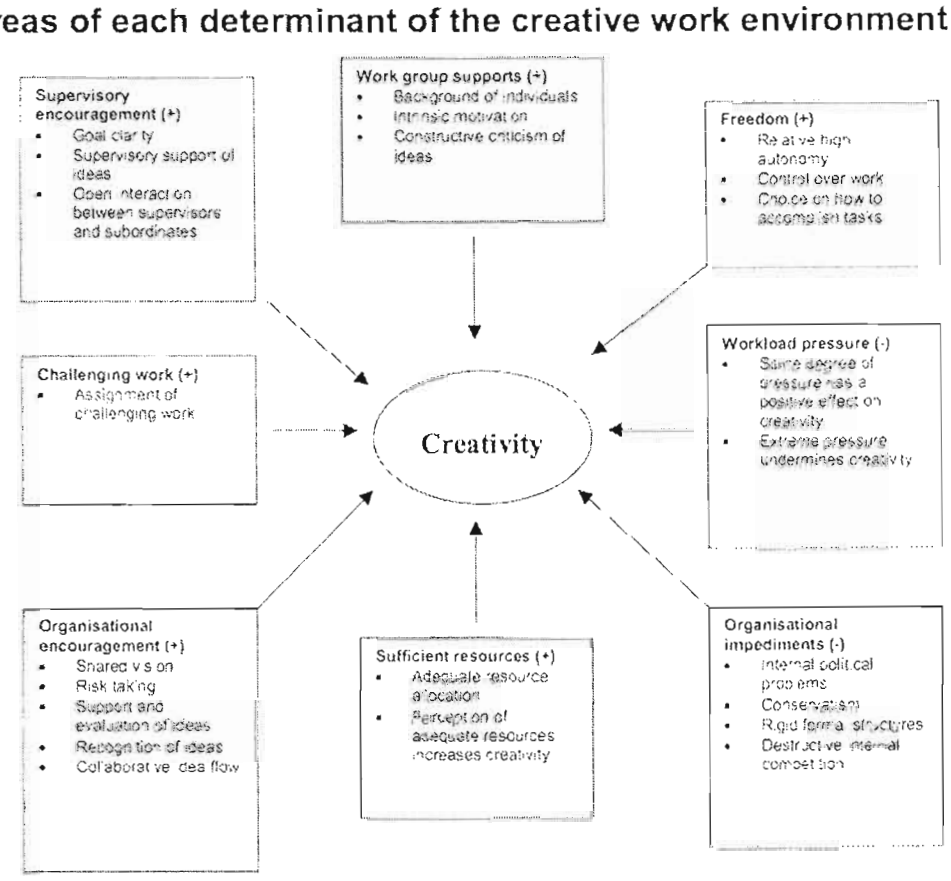


Figure 1.14 Determinants of the Creative Work Environment

1.5.2 TOOLS FOR ASSESSING CREATIVITY

In our search for a reliable and appropriate measurement model of creativity in the workplace, we turned to Mathisen's (2004) comparison of 5 leading models.

Mathisen evaluated the following models on their factor structure, reliability, and validity:

1. KEYS: Assessing the Climate for Creativity
2. Creative Climate Questionnaire
3. Situational Outlook Questionnaire
4. Team Climate Inventory
5. Siegel Scale of Support for Innovation

Mathisen found that the KEYS instruments was "of acceptable scientific quality and well documented in peer-review literature" (2004, p.1). He goes on to state that the model "demonstrated acceptable reliability and validity" (p.128) and scores particularly well when compared to the other tools. Proving the best of Mathisen's evaluation, we selected the KEYS tool to measure the independent variables of creativity the work environment in the framework of our study.

1.5.3 SUMMARY

In this last section of chapter one, we presented Amabile's KEYS model (1996) for measuring creativity in the workplace. We find it intriguing how closely the elements of a creative work environment mirror the intended benefits sought and claimed by Agile project management practices. Scrum in particular, with its specific roles, artifacts, communications patterns, and project process seems uncannily aligned with the freedom, challenging work, work group support, feedback, manageable work-load pressure, and the removal of political and resource impediments proven to be keys to creativity. As such, we hypothesize that the reason why Agile practices are attractive in innovative projects is that they are inherently conducive to a creative work environment - given that creativity is the seed of innovation (Amabile, 1996).

Next we present a concise summary of this literature review.

1.6 LITERATURE SYNTHESIS

The table below synthesizes the key contribution retained for this research.

Author	Key Contribution	Pertinence to this research
1.1 TRADITIONAL PROJECT MANAGEMENT		
PMI (2004)	Project management body of knowledge (PMBOK)	Example of one of the most popular traditional project management methodologies
OGC (1996)	Projects in controlled environments - second version (PRINCE2)	Example of one of the most popular traditional project management methodologies
SEI (date)	Capabilities Maturity Model Integration (CMMI)	Example of one of the most popular traditional project management methodologies
1.2 THE NEED FOR INNOVATION IN PROJECT MANAGEMENT METHODS		
Boehm (2002)	Risk-exposure analysis of project management practices	Traditional project management is inappropriate in projects that require creative problem-solving
Dinsmore (2006)	Project management differs by industry	The IT industry is characterized by a need for non-traditional project management models
Dinsmore (2006)	Proprietary project management system as Ericsson	Empirical evidence that there is a need for alternate project management models in highly innovative industries
Duggal (2001)	Project management offices (PMO) should be replaced by Innovation Project Offices (IPO)	The field of project management needs to be lighter, faster, and more flexible in light of uncertainty and innovation
Parmentier (2007)	The concept of ambidexterity in project management models	Highly creative, innovative, high-tech industries require alternatives to traditional project management models
Shenhar (2007)	The Diamond model for evaluating project management needs	Innovation is a key element in determining appropriate project management methods

Author	Key Contribution	Pertinence to this research
Williams (2005)	Principle causes of project overruns	Traditional project management methods are ineffective at dealing with structural complexity, uncertainty, and tight time-constraints - hence the need to examine alternatives
1.3 AGILE AS AN INNOVATIVE PROJECT MANAGEMENT METHOD		
Abrahamsson (2003)	An analysis of various Agile methods	Scrum is a valid and appropriate measure of Agile project management in the workplace
Agile Alliance (2001)	Agile was founder in an attempt to improve project management	Agile is an alternative project management model for high-uncertainty and high-technology industries
Augustine (2005)	Compares the theory of complex adaptive systems (CAS) to Agile project management principles	The key practices of CAS parallel those of Agile project management and those of creative work environments - supporting the idea of potential correlation.
Schwaber (2004)	Scrum as an Agile project management method	***Dependent variables***: Scrum practices as related to creativity in the workplace
Schwaber (2007)	Methods for scaling Scrum to the enterprise.	This research investigates Agile and creativity at the enterprise level, not only at the project level.
Takeuchi, Nonaka (1986)	Credited as the origin of Agile project management, they provide 6 base principles on which all others have built upon.	Agile has become a buzz-word that can have many interpretations. Their work is used as the originating definition of Agile.
1.4 AGILE WORKS IN INNOVATION PROJECTS		
Baskerville (2006)	Identifies the 6 most common Agile practices and their impacts	The implementation of these Agile practices is measured against a creative work environment.
Berger (2007)	The need for cultural-fit with Agile practices, and how bureaucracies present barriers to Agile and the creative process	Traditional project management fits better with bureaucratic culture, and Agile project management fits better creativity culture.

Author	Key Contribution	Pertinence to this research
Boehm (2005)	Empirical evidence on the management challenges of implementing Agile	These management challenges may equally threaten a creative work environment.
Karlstrom (2005)	The impacts of Agile project management when used within a traditional "stage-gate" process	Many of these impacts are related to a work environment that is conducive to creativity.
1.5 CREATIVITY IS A FACTOR OF INNOVATION		
Amabile (1996)	KEYS model for measuring creativity in the workplace	***Independent variables***: The KEYS questionnaire for measuring creativity in the workplace
Mathisen (2004)	Evaluation of tools for measuring creativity in the workplace	KEYS is a valid and reliable measure of creativity in the workplace

Table 1.5 Literature Synthesis

CHAPTER II

RESEARCH OBJECTIVE

Project management needs theory, by developing and testing appropriate measures, which required the conceptualization and measurement of the concept and its derivative constructs. Similarly, the present state of reliable measures in Agile project management is inadequate. Without reliable measures, results remain questionable. There have been few attempts to measure Agile project management practices with the goal of developing a theoretical foundation. Many speak of the process of project management, but few have measured it quantitatively (measuring variation in dependent variables through independent variables). Current Agile research is narrative and descriptive - not allowing for a measured understanding of the relationships at work. These sources are of limited use for testing theories. This research seeks to both establish a tool to measure Scrum project management practices and use that tool to conduct a study against creativity in the workplace.

Most of the current literature on project management uses a classificatory approach - placing projects into typologies, in hopes of understanding them through stereotyping. This research, in contrast, uses a comparative approach - used to identify and measure the key traits or dimensions of the constructs. To this end, we make a first attempt at defining the variables (observable) and constructs (non-observable) that constitute Scrum. Given that "all theories in science concern statements mainly about constructs rather that about specific, observable variables" (Nunnally 1978: Venkatraman, 1989) the process of construct development and measurement is at the core of theory construction. The constructive process is the first objective of this research.

Agile project management, and the measures developed in this research, are strictly process (means) and do not attempt to measure goals or results (ends). These measures remain consistent with the current literature on Agile practices. The literature implies that the proper process (for example Scrum practices) will lead to the desired results (successful projects). It must be stressed, however, that there is no mention of the specific definition or measures of project 'success', which makes evaluating the process very difficult. Nonetheless, the literature does state that Agile and Scrum are 'well suited' to software development and new product development in general (Agile Alliance, 2001). Assuming this to be true - from previous narrative and descriptive research results - our hypothesis states that Agile, and Scrum in particular, fosters a creative working environment; and that this environment contributes to the successful execution of innovation projects, which may in-turn contribute to the successful completion of said projects. The underlying theory is that these projects need innovation, and that innovation is seeded in creativity, and that project management practices can foster or hinder creativity in the workplace.

2.1 PROBLEM STATEMENT

Many project managers are finding themselves asking the question:

Should I implement Agile project management for my project?

Many companies engaging in new product development (NPD), research and development (R&D), and information technology (IT) projects do not consistently achieve satisfactory results when implementing traditional project management methodologies - projects that require high levels of innovation (Dinsmore, 2006; Shenhar, 2007). The traditional, linear, anticipatory processes of

traditional project management do not seem to lend themselves well to the uncertainty and volatility inherent in these types of projects. Consequently, many companies are turning to Agile's iterative, incremental, empirically-based methods of project management (Baskerville, 2006).

To answer the simple question of "should I implement Agile", we were led to consider the more revealing question of:

"Why is Agile project management popular in these types of projects?"

Due to the many similarities in the goals that Agile was tailored to achieve and the preconditions necessary for a creative work environment, this research hypothesizes that the reason why Agile works well in these specific types of projects is that they require high levels of creativity from their teams. And from the research on innovation (Amabile, 1996) we know that creativity is a first step towards innovation. Thus, we infer that Agile fosters innovation. Furthermore, as Agile has many manifestations, and we are interested in project management practices in particular, Scrum is our chosen methodology with which to formulate our problem statement. Thus, it is expressed as:

"Do Scrum project team members perceive their environments as conducive to creativity?"

Should this statement prove to be true, then project managers would be able to replace their ambiguous question of "Is Agile project management a good choice for my project" with the more concrete questions of :

"Does my project require a high degree of creativity?"

We saw in chapter one that the existing literature on Agile is almost entirely prescriptive - simply explaining what the recommended practices are, and that they are appropriate for all new product development environments. Little literature has been found on the evaluation of these processes and their impacts. Companies such

as the participant of this research project are therefore hungry for information that will assist them in their decisions to support or reject Agile project management practices within their organizations.

2.2 RESEARCH QUESTION

In order to satisfy our research objective, and in response to our problem statement, the research question and title of this project is:

"How are Agile project management practices consistent with a creative work environment?"

In the next chapter we present the conceptual model and hypothesis that will be used to answer our research question.

CHAPTER III

CONCEPTUAL FRAMEWORK AND HYPOTHESES

This chapter elaborates the concepts of project management upon which this research is built, and through which we aim to answer our research question.

3.1 RESEARCH POSITION

At the highest level, we explore the relationship between project management, Agile project management practices, and innovation in projects. Given that Agile was conceived as a specific type of project management in the goal of achieving greater and faster innovation, the intersection of these three subjects represent our research position (see figure 3.1).

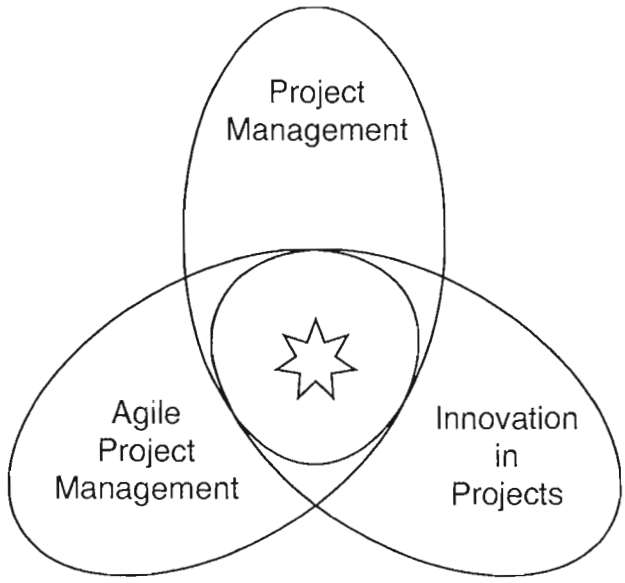


Figure 3.1 Research Position

3.2 CONCEPTUAL FRAMEWORK

Reviewing current literature we find that creativity is an important factor in achieving innovation in products and services. Amabile (1996) found eight characteristics of a work environment that is conducive to creativity - namely employee freedom to share ideas, challenging work that motivates employees to think beyond the status quo, sufficient time resources to accomplish the work effectively, supervisory encouragement to take risks with confidence, organizational encouragement to innovate processes as well as products, reduces organizational impediments due to politics and bureaucracy, and lesser workload pressure with time to explore, share, and develop ideas (Amabile, 1996).

Coincidently, Agile project management was designed with very similar goals. The Agile Manifesto (Agile Alliance, 2001) enumerates early, continuous feedback to validate ideas, flexibility and responsiveness to changes, frequent, informal communication among all members of the team, motivated individuals in an empowered and trusting work environment, progress measured in terms of deliverables, pride and quality, focus on value, self-organizing teams, and an inspect-and-adapt approach to processes. As illustrated in figure 3.2, we propose that the practices advocated by Agile encourage the same characteristics of a work environment required to promote creativity. Should this be proven true, it would answer our problem statement of:

"Why might Agile project management work well in innovation projects?"

with the response:

"Because Agile fosters a work environment that is conducive to creativity - and creativity is a source of innovation."

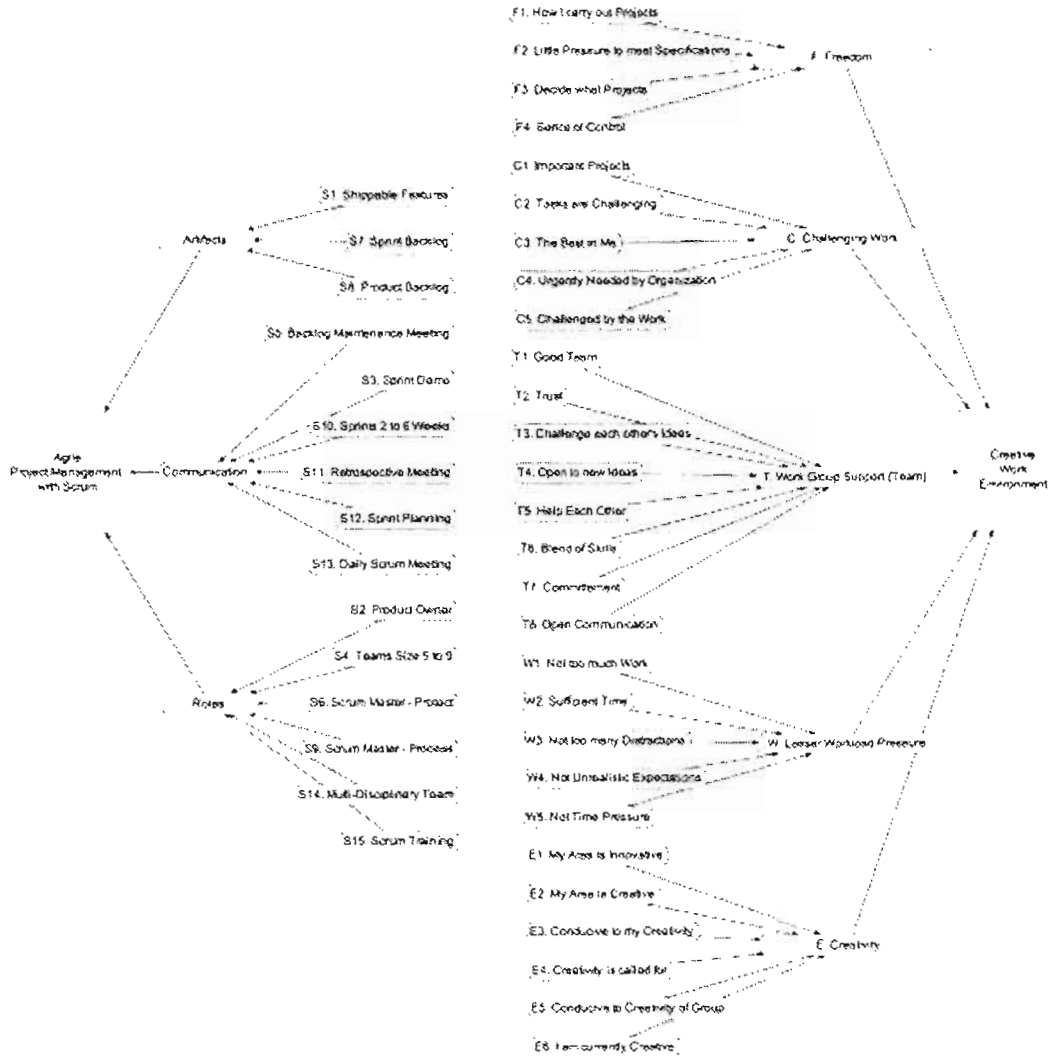


Figure 3.2 Conceptual Model - Scrum and Creativity

3.2.1 POTENTIAL OF THE CONCEPTUAL MODEL

This section details the conceptual framework by exploring the potential relationships between factors of a creative work environment (Amabile, 1996) and Agile project management with Scrum practices (Schwaber, 2004). We will present

each creative factor and hypothesize on how various Scrum practices might foster their presence in project environments.

3.2.1.1 FREEDOM

The first measure of creativity explores the notion of freedom. In this context, freedom is described as the how free we feel to choose the projects we work on and how we carry-out our tasks. To be free, we should feel little pressures to meet others' specifications on how we accomplish our tasks - thus feeling a sense of control over our daily work.

In Scrum, there are several practices that could reinforce this freedom. Firstly, project staff form teams of five to nine, multi-disciplinary members. Although not explicitly stated, it can be imagined that this process be voluntary - whereby employees are free to accept or decline appointment to a project, and further free to choose their teams.

Simple project roles - of product owner, scrum master, and team member - help to reduce formal hierarchy and promote every individual's freedom to contribute and participate.

The project backlog - serving as the requirements of the project - is worded as functional requirements, that make no mention of implementation specifications. The requirements are business needs, and leave the technical implementation to be explored, evaluated, and selected by the project team. This potentially give employees the freedom choose how they carry-out and deliver the project.

The sprint planning meeting stands-out as potentially the most freedom-supporting practice in Scrum. During this meeting, the team discusses the required features at the top of the product backlog (as its items are prioritized by business value) and agree on how they are going to implement each item. They proceed down the list, detailing their implementation and estimates of time, until the team decided that their

capacity is reached for that iteration, and that they cannot commit to delivering any more. Therefore, the team chooses what item they are going to deliver, how they are going to deliver them, while controlling their workload.

Similarly, the product backlog maintenance meetings have the goal of keeping the product backlog in good health. The product owner and team members work together to ensure that backlog items are clear and sufficiently detailed so that sprint planning meetings, and the project as a whole, can unfold as effectively and efficiently as possible. This opportunity to ask questions, discuss options, and consider alternatives can be perceived as providing the team with great freedom in their work.

Finally, the sprint retrospective meeting provides the team with the opportunity, and obligation, to reflect on their work methods. It is during this meeting, held at the end of each sprint, that team members address what worked well and what work less well in their process, and are encouraged to take appropriate actions to improve their working environment.

These practices, both individually and combined, have the potential to support the freedom employees need to be creative in the workplace.

3.2.1.2 CHALLENGING WORK

The second measure of creativity in the workplace is that of challenging work. The KEYS model defines challenging work as one that is perceived as important and urgent to the organization, and that motivates the employee by pushing them to the limits of their abilities.

Scrum practices provide several opportunities to enforce this challenge. Firstly, client involvement directly in the Scrum teams can be an important part of brings business urgency and importance to the team members. Without such involvement, teams can quickly find themselves at a loss for perspective and relevance in the larger, business

picture. However, having the client available and engaged in the sprint activities ensures that teams remain aware on the business deliverables.

Secondly, teams are multi-disciplinary, forcing all members to approach solutions not only from the perspective of their own profession and background, but from all disciplines combined. For example, this could mean that information technology staff discuss options with marketing staff, who in-turn clarify the business strategy interests - and this on a daily basis. Such situations can arguably push project staff beyond their usual considerations, challenging them in new and interesting ways.

Similarly, simplified roles and flattened hierarchies in Scrum can remove the barriers around more traditional, specialized roles. A 'junior' might normally be reluctant or even prevented from presenting ideas in the presence of a 'senior'. A database administrator might not otherwise share his insights on the target-market of their product. But the simplified roles and multidisciplinary teams found in Scrum are designed to open these walls - potentially challenging everyone involved.

Sprint planning and product backlog maintenance meetings are the moments where team member decide on the implementation details of their work. Therefore, these occasions provide team members with ideal opportunities to present and justify challenging alternatives. Conversely, they are forced to consider and question the propositions of others - possibilities that might never have been explorer had specification been provided and dictated by project documentation.

Finally, sprint retrospective meetings provide an opportunity to address all problems - including any lack of challenging work. Possibilities include better distribution of tasks, redefinition of roles, a change in team membership, or even a transfers to another project.

3.2.1.3 WORK GROUP SUPPORT

Team-work is a third measure in the model, defining the necessary work group as "a diversely skilled work group in which people communicate well, are open to new ideas, constructively challenge each other's work, trust and help each other, and feel committed to the work they are doing." (Amabile, 1996).

Scrum teams are similarly defined as being multi-disciplinary to favor exchange of expertise. Team size is to be kept between 5 and 9 members to optimize communication and allow to team to self-manage. Within the team there is little hierarchy, to encourage everyone's participation, and requiring collective responsibility for the work to which they commit. Another benefit to small team is that the members can more easily be co-located - greatly facilitating continuous, informal communication. Finally, during the daily Scrum all team members communicate their work and have the opportunity to ask for help - ensuring that difficulties do not linger for more than one day.

For these reasons, the Scrum team could potentially score well in the measure of work group support.

3.2.1.4 LESSER WORKLOAD PRESSURE

Workload pressure is defined as - "Extreme time pressures, unrealistic expectations for productivity, and distractions from creative work." (Amabile, 1996).

The sprint planning meeting is the tool against excessive workload pressure. During these meetings, teams choose the amount of work that they can commit to for the iteration. They detail their tasks based upon the most recent information they have from work already completed, the time required to complete each, as well as their individual capacities. Furthermore, sprint burn-down charts are designed to only

measure the time remaining for the tasks - not the time spent - preventing managers from placing too much 'plan-driven' time pressure on team members and favoring more constructive 'planning-driven' alignment with the reality of project execution. The burn-down chart focuses attention to the team's total capacity versus the total amount of work remaining - no individual person is pointed out.

Finally, during the daily Scrum meeting, members are required to brief the team on what they are working on and, most importantly, what help they need to overcome obstacles. Unforeseen obstacles and interruptions, either technical or organizational, can increase time and workload pressure. This meeting is designed to quickly address these matters, on a daily basis.

3.2.1.5 CREATIVITY

A creative work environment is one where not only the work group produces creative ideas, but also where individuals are able to contribute their personal creativity. Should a project member perceive him/herself to be able to express their creativity it can be argued that that member will provide more valuable contribution to the project. They may be more motivated, more likely to spot omissions and risks, and more able to find solutions. Agile project management was designed to meet the needs of projects with high uncertainty, changing requirements, and important time constraints (Agile Alliance, 2001; Schwaber, 2004). Our study suggests, and tests, that Scrums may foster a work environment where its members use their creativity to meet such challenges.

3.3 RESEARCH HYPOTHESES

Our objective is to answer the research question by means of testing the following hypothesis:

H1: People who perceive a proper application of SCRUM project management practices will perceive their work environments as conducive to CREATIVITY.

This principal hypothesis can be further decomposed into the granular hypotheses below:

H1.1: People who perceive a proper application of SCRUM project management practices will perceive their work environments as providing FREEDOM.

H1.2: People who perceive a proper application of SCRUM project management practices will perceive their work environments as providing CHALLENGING WORK.

H1.3: People who perceive a proper application of SCRUM project management practices will perceive their work environments as providing WORK GROUP SUPPORT.

H1.4: People who perceive a proper application of SCRUM project management practices will perceive their work environments as providing manageable WORKLOAD PRESSURE.

H1.5: People who perceive a proper application of SCRUM project management practices will perceive their work environments as enabling personal CREATIVITY.

3.4 SUMMARY

We presented our conceptual model and the potential relationships between Agile project management practices and the factors that characterize a creative work environment. We also presented our hypotheses, specific statement that can be tested in order to answer our research question. Should such a relationship be found to exist, it would partially explain why Agile project management sees favorable results when applied to projects that require innovation.

In the next section we will describe how we intend to test these hypotheses, presenting our research methodology.

CHAPTER IV

RESEARCH METHODOLOGY

This project uses a quantitative research methodology in an attempt to measure the potential relationships between Scrum and creativity in the workplace, as shown in our conceptual framework (see chapter three). In order to measure Scrum, this research proposes a new measurement tool, as none were found to exist in the current literature. This tool is newly defined by the author, and has never before been tested empirically.

In order to measure creativity in in the workplace, this research reuses the KEYS to creativity tool developed and validated by Teresa Amabile (1996). This tool has been revalidated by other authors (Mathisen, 2004).

4.1 NATURE AND PROCESS OF THIS RESEARCH

4.1.1 RESEARCH PERSPECTIVE

Although rarely stated, it can be helpful to understand the philosophies of the researcher conducting the project. Our perspectives, opinions, and interests are greatly influenced by our experience, training, and backgrounds (Ven de Ven, 2007). Stating our philosophies can help other, and ourselves, better recognize and situate our natural biases.

This researcher subscribes to the philosophy of critical realism. Realism is defined as:

"Philosophical movement characterized by the existence of a mind-independent reality and the ability of a theory to capture partial aspects of reality" (Van de Ven, 2007)

Critical realism follows an objective ontology that believes reality to be independent of our perceptions and cognition (Van de Ven, 2007). Even though we experience reality though the filters of our experience, reality exists, in an of itself, regardless of whether or not we see its truth.

4.1.2 UNIT OF ANALYSIS

This study measures the *perceptions of individual team members* pertaining to their work environment and their project management practices. The KEYS questions (Amabile, 1996) are used to measure the individuals perception of how conducive their work environment is to creativity. Questions pertaining to prescribed Scrum practices (Schwaber, 2004) are used to measure to what extent the individual perceives the implementation of Scrum project management as adequate. Figure 4.1 below provides a graphic representation of the unit of analysis.

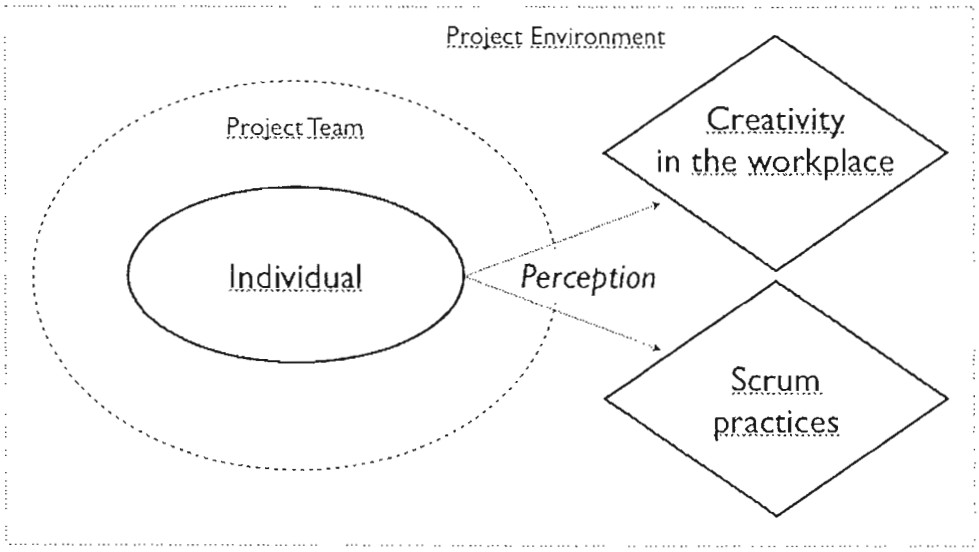


Figure 4.1 Unit of Analysis

4.1.3 QUANTITATIVE APPROACH

RESPONSE SCALE

In their publication "Applied Multivariate Research", Meyers et al. (2006) describe the Likert summative response scale as "acceptable, appropriate, and quite useful" as a statistically valid measurement of the continuum intervals of people's attitudes and perceptions. As such, this research implements a four-point Likert scale as follows:

1. Never
2. Sometimes
3. Often
4. Always

The statistical appropriateness of this measure allows for the quantitative analysis of the correlation, should any exist, between the independent variables - Scrum project management practices, and the dependent variables - the aspects of a work environment that are consistent with high creativity.

Having an even numbered scale, of four points, where no neutral midpoint is available for selection by the respondent, forces the respondent to take position. Those who might otherwise be tempted to simply respond neutrally are, in this case, forced to reflect further and decide if their neutrality actually favors a positive or negative position. We found this to be appropriate and favorable for our study, as our unit of analysis deals with perceptions - which can have subtle variances. We prefer to measure subtle tendencies towards positive or negative perceptions than masking such subtleties behind a generalization of neutrality.

Furthermore, this scale is consistent with the «Keys to Creativity» survey (Amabile, 1996) upon which this study relies. As such, it was important to minimizes any changes made to this survey in order to maintain its integrity.

For the purpose of analysis, a fifth score is assumed at the mid-point of the scale, and the scores are therefore translated into the following (3 becomes 4, 4 becomes 5):

1. Never
2. Sometimes

(3. neutral mid-point)

4. Often
5. Always

This provides the neutral division by which scores can be grouped as "High" for responses "Always" and "Often", and grouped as "Low" for responses "Sometimes" and "Never". This dichotomy aggregates the results to a level of detail that is pertinent for the purposes of this study.

Thus, this study can make use of both the raw four-point scale and the aggregated two-point scale to analyze the results.

4.1.4 RESEARCH POPULATION

This research takes place within an international video-game development company. As a project-based organization of more than 4000 employees, it is forever seeking potential improvements in its project management practices. Introduced from a bottom-up initiative, interests and experimentations with Agile project management with Scrum have inspired top management to embark on a formal evaluation of the framework. This setting presents an appropriate and valuable source of empirical data for this research project.

4.1.4.1 STUDY INDUSTRY

We selected the video-game industry for its strong dependency on creativity. It therefore presents somewhat of a critical case that, it is hoped, accentuates the potential relations between project management practices and creativity in the workplace. One might say that we adopted the perspective of "if it doesn't work here, it won't work anywhere". The video-game industry, much like that of Hollywood movies, operates in an environment of continuous new product development - each being held to high standards of innovation and creativity. This type of innovation and creativity is exceptional because the products not only have to present some uniqueness, high quality, and reliability (much like any other product), but video-games must also deliver the extremely elusive element of "Fun". It is this intangible element that characterizes video-games as not only "science", but equally "art". Video-Games must immerse their users in fantastic worlds - using ever-improving visuals, sounds, controls, characters, and stories; criteria that few other products and services are required to meet. To do so, the video-game industry pioneers new technologies and new processes, relying heavily on creativity for ideas in both products and processes, and on project management to deliver it all.

4.1.4.2 STUDY COMPANY

Our case company is characterized as follows:

- Large population (4000)
- Multi-national
- Uniform corporate culture
- Resource-based culture, valued employees
- Project-based organization, strong project culture
- Wide adoption of Agile project management (Scrum)

- Mix of project management methods throughout the organization

4.1.4.3 SAMPLING

Our sampling technique follows a purposive or judgmental method (Beaud and Gauthier, 1992 p.205). As such, our participants were not selected at random from within the study population. Instead, participants were targeted particularly for their potential experience with the study subject matter - namely Scrum project management. Within the company of four-thousand (4000) employees, organized by project rather than by function, a sample of approximately five-hundred (500) project employees were targeted to participate in the study, as their projects were said to be using Scrum project management practices - by at least some of the project members. These employees, representing twenty-five percent (25%) of the population, were distributed across three (3) principle locations - namely Canada, China, and England. More detail on their profiles is provided in results of chapter six.

4.1.4.4 INVITATION

All project staff were solicited for the survey; from project management, to teams members, to support staff. The survey was completed freely and anonymously. Participants were solicited by a general invitation sent to their teams by email. In some cases, this email was sent by the team's lead project manager (Producer), and in other cases the email was sent by the researcher - as a member of the internal research department and as an internal employee. A reminder invitation was sent one week after the initial invitation. Responses were excepted for a period of 3 weeks from the time of invitation.

4.2 DATA COLLECTION TOOLS AND METHODS

This section provides details on how the questionnaire was built and how it was conducted as a web-based survey.

4.2.1 RESEARCH VARIABLES AND QUESTIONNAIRE

The following section will present the research variables, both independent and dependent, in the form of research questions. The questionnaire consists of fifty-three (53) questions. Five (5) questions profile the respondent. Twenty-eight (28) creativity questions were taken directly from the KEYS survey (Amabile, 1996); the details of which are presented later as the dependent variables. Seventeen (17) questions were designed by the researcher pertaining to Scrum project management practices; the details of which are discussed under the independent variable. Finally, a single (1) question on the last page asked for general comments about the survey, but was not analyzed in the context of this project.

4.2.1.1 DEPENDENT VARIABLES - CREATIVITY IN THE WORKPLACE

The dependent variables in this research are taken directly from the KEYS to Creativity measurement tool (Amabile, 1996). The model consists of 10 measures, each consisting of between four and fifteen individual variables. The tool divides creativity into 10 constructs:

Creativity constructs:

1. Freedom
2. Challenging work
3. Work Group Support
4. Supervisory encouragement

5. Organizational support
6. Organizational impediments
7. Workload pressure
8. Sufficient resources
9. Creativity
10. Productivity

However, for the purposes of this research project, only those five (5) constructs directly concerned with project and project members were retained. These five constructs were found to target the same benefits as Scrum project management practices, and were identified as pertinent measures for our research objectives. These five constructs are:

1. Freedom
2. Challenging work
3. Work Group Support
4. Workload pressure
5. Creativity

Below we detail the variables, or questions, that form each of the five constructs.

Freedom: Deciding what work to do or how to do it; a sense of control over one's work.

1. I have the freedom to decide how I am going to CARRY OUT my PROJECTS.
2. I feel little PRESSURE to meet someone else's specifications in how I do my work.
3. I have the freedom to DECIDE WHAT PROJECT(s) I am going to do.

4. In my daily work environment, I feel a SENSE OF CONTROL over my own work and my own ideas.

Challenging work: A sense of having to work hard on challenging tasks and important projects.

5. I feel that I am working on IMPORTANT PROJECTS.
6. The TASKS in my work are CHALLENGING.
7. The tasks in my work call out THE BEST IN ME.
8. The ORGANIZATION has an urgent NEED for successful completion of the work I am now doing.
9. I feel CHALLENGED by the WORK I am currently doing.

Work group support : A diversely skilled work group in which people communicate well, are open to new ideas, constructively challenge each other's work, trust and help each other, and feel committed to the work they are doing.

10. My co-workers and I make a GOOD TEAM.
11. There is a feeling of TRUST among the people I work with most closely.
12. Within my work group, we CHALLENGE each other's IDEAS in a constructive way.
13. People in my work group are OPEN TO new IDEAS.
14. In my work group, people are willing to HELP EACH OTHER.
15. There is a good BLEND OF SKILLS in my work group.
16. The people in my work group are COMMITTED to our work.
17. There is free and OPEN COMMUNICATION within my work group.

Workload Pressure: Extreme time pressures, unrealistic expectations for productivity, and distractions from creative work.

18. I do NOT have too MUCH WORK to do in too little time.
19. I have SUFFICIENT TIME to do my project(s).
20. There are NOT too MANY DISTRACTIONS from project work in this organization.
21. There are NOT UNREALISTIC EXPECTATIONS for what people can achieve in this organization.
22. I do NOT feel a sense of TIME PRESSURE in my work.

Creativity: A creative organization or unit, where a great deal of creativity is called for and where people believe they actually produce creative work.

23. My AREA of this organization IS INNOVATIVE.
24. My AREA of this organization IS CREATIVE.
25. Overall, my current work environment is conducive to MY OWN CREATIVITY.
26. A GREAT deal of CREATIVITY is called for in my daily work.
27. Overall, my current work environment is conducive to the CREATIVITY of my work GROUP.
28. I believe that I AM currently very CREATIVE in my work.

These questions represent the dependent variables of our research. In the next section, we present the independent variables of Scrum.

4.2.1.2 INDEPENDENT VARIABLES - SCRUM PRACTICES

The independent variables in this research were developed by the researcher - having not identified any appropriate, existing tools for measuring Scrum project management practices in the literature. The researcher, himself, is a twice certified Scrum Master and an active practitioner of Scrum project management practices.

The questionnaire was developed primarily from Ken Schwaber's (2004) book on Scrum. The questionnaire was then validated with a certified Scrum trainer, hired by the study organization to aid in the training, implementation, and application of Scrum within select project teams. This validated the questions for their accuracy of Scrum practices according to the certification standards to which trainers are held. Furthermore, this validated that, indeed, Ken Schwaber's (2004) book is used as a primary reference for certification professionals.

The questions were, finally, validated with operational managers and a division director of the participating organization in order to validate their consistency and pertinence with the organization's practices and vocabulary of Scrum project management.

The Scrum questions are grouped into three measures - namely roles, artifacts, and communication. These grouping are an initial attempt by the researcher to develop implicit Scrum constructs from the explicit core practices; the goal being to measure the impact of these constructs on those of the dependent variable constructs of creativity. These grouping do not come from the literature, as no such groupings exist. Below we detail the variables of these constructs.

Scrum Roles:

1. We have a Product Owner who is available when he/she is needed.
2. My team has a Scrum Master who makes the team and Product Owner follow the Scrum process.

3. My team has a Scrum Master who protects the team from interruptions during the sprint
4. My team is multi-disciplinary having members from various disciplines and professions.
5. My team consists of 5 to 9 people.

Scrum Artifacts:

6. My team maintains a product backlog of prioritized requirements.
7. My team maintains a sprint backlog of work in progress.

Communication in Scrum:

8. My team holds a sprint planning meeting at the beginning of each sprint.
9. My team's uses sprints that are a consistent length and between 2 and 6 weeks long.
10. My team produces potentially shippable features each sprint.
11. I participate in daily Scrum meetings.
12. My team holds regular product backlog maintenance meetings to keep the product backlog up to date.
13. My team holds a sprint demonstration meetings at the end of each sprint.
14. My team holds a sprint review/retrospective meeting at the end of each sprint.
15. My team receives sufficient Scrum training.

4.2.1.3 SURVEY TRANSLATION

The entire survey was made available in both English and French. The content of the survey was double-translated (or back-translated) according to the recommendations of Brislin (1970). Brislin found this method to be effective in maintaining the just meaning of survey questions when translation is necessary. Following this method, the original survey was first written in english. Then, a bilingual person proceeded to translate the survey into French. A second bilingual person then retranslated the French version back into English. Finally, the two english versions were compared for any significant differences that would affect consistent comprehension and response. Ultimately, only minor adjustments were made to ensure the coherence of the two surveys so that the results could be pooled into a single data set.

4.2.1.4 SURVEY PRETEST

The survey was pre-tested with ten senior members of the organization that were familiar with Scrum and the creativity objectives of the company; and were therefore able to confirm the pertinence of the survey content. Furthermore, all ten pre-testers were fluently bilingual in French and English and were therefore able to confirm the clarity and accuracy of the language and phrasing.

The pre-test phase brought about several corrections to the text, phrasing, and vocabulary (Scrum questions only) - but did not require any changes to the survey content.

4.2.1.5 WEB-BASED DATA COLLECTION

Response data was collected via the web-based survey tool at www.surveymonkey.com - for which a full copy is presented in appendix B. This

tool was selected for the convenience of a geographically independent web-based tool, as the survey was conducted in three countries. This tool provided support of multiple languages, necessary as the survey was conducted in both English and French. Data was automatically and securely stored in electronic format, and remained accessible at all times. Furthermore, the data was stored in a format that could be directly imported into statistical verification and analysis tools. The survey tool offered multi-session support, had the participants wished to complete the survey over multiple sittings.

Another advantage of using this tool was the fact that it provided third-party anonymity. Survey participants could see that their responses were not being captured directly by their employer, potentially increasing their confidence in being open and truthful without fear of reprisal.

Finally, SurveyMonkey is a trusted, reputed company, with whom the university conducts multiple surveys.

CHAPTER V

NEW SCRUM MEASUREMENT MODEL

Having not found a Scrum measurement model in existing literature, it was necessary to develop a new model in order to address and answer the research question. This additional step in our methodology was not anticipated. Nonetheless, the development and validation of the new Scrum Measurement Model remains one of the most significant contributions of this research project.

5.1 INITIAL SCRUM MODEL

5.1.1 SCRUM VARIABLES

Based upon current Scrum literature, and principally that of Ken Schwaber (2004), the major Scrum project management practices can be summarized by fifteen (15) individual items. These items refer to: the roles that are defined in the Scrum structure, the meetings and communications that take place between members of the Scrum team, and the documents and artifacts that are part of the Scrum process. The items are:

1. Product Owner role
2. Scrum Master enforces the Scrum process
3. Scrum Master protects the team from interruptions
4. Multidisciplinary teams
5. Teams of 5 to 9 members
6. Product backlog
7. Sprint backlog
8. Sprint planning meetings

9. Sprints of 2 to 6 weeks
10. Potentially shippable features
11. Daily Scrum meetings
12. Product backlog meetings
13. Sprint demonstration meetings
14. Sprint review meetings
15. Scrum training

5.1.2 SCRUM VARIABLE VERIFICATION

The Scrum variables were drawn from and verified according to the literature. As a second source of verification, the variables were presented to subject-matter experts. The goal being to verify that the variables did indeed adequately summarize and represent the major practices of Scrum project management. The items were presented to a Certified Scrum Coach - who trains Scrum teams and certifies Scrum Masters. Several certified Scrum Masters were presented the model for their input. Finally, several members of management at the participating organization were presented the variables to ensure that they were indeed aligned with the organization's understanding and application of Scrum practices.

As a result, no changes were required in the set of variables. The next step was to group the variables into measures.

5.1.3 SCRUM MEASURES

In the context of a research study, the Scrum items equate to variables - not measures. At the highest level, these fifteen variables can be said to measure Scrum - as a whole. However, in this research project, it was not only of interest to examine how Scrum as a whole might be consistent with creativity, but it was also interesting to understand if, perhaps, there might be parts of Scrum that were more of less

important in explaining creativity. Therefore, it was necessary to group these fifteen items into sub-concepts within Scrum. These sub-concepts would equate to measures of Scrum. The measures themselves are implicit, and are not directly observable - other than through the variables that define each of them. We see the same logic in the KEYS to Creativity model (Amabile, 1996), whereby Creativity is made up of ten (10) constructs or measures, and these measures are made up of seventy-eight (78) items or variables.

Looking at current literature, we find no proposed, let alone validated, groupings or sub-concepts of Scrum. Many agree that the principles are common and accepted (Baskerville, 2006; Berger, 2007; Boehm 2005; Karlstrom, 2005), but they all treat Scrum as a whole, undivided concept. Therefore, it became necessary to make a first attempt at defining the measures within Scrum. Examining the fifteen items, it was possible to group them logically according to three (3) constructs; namely: roles, artifacts, and communication practices. This grouping provided the model with which the study was conducted:

Roles:

1. Product Owner
2. Scrum Master enforces the Scrum process
3. Scrum Master protects the team from interruptions
4. Multidisciplinary teams
5. Teams of 5 to 9 members

Artifacts:

6. Product backlog
7. Sprint backlog

Communication:

8. Sprint planning meetings
9. Sprints of 2 to 6 weeks
10. Potentially shippable features
11. Daily Scrum meetings
12. Product backlog meetings
13. Sprint demonstration meetings
14. Sprint review meetings
15. Scrum training

The items were finally reworded as survey questions, in such a way that they could be answered according to the desired response scale (four-point Likert scale, see section 4.1.3).

In the next section, we explain that the results from this model were found to be invalid, and how the model, therefore, had to be revised.

5.2 SCRUM MODEL RESULTS AND VALIDATION

We began our methodology approach with an "a priori" approach, whereby we defined the dimension of Scrum as we thought they should be, and then validated those measures with the survey results. Our first goal was, therefore, to confirm or reject our measurement model. Our second objective was to expose any existing correlations between our Scrum model and elements of that of the KEYS to creativity. In the end, however, our Scrum model, as it was grouped, did not prove to be consistent or reliable, and was hence rejected.

We, therefore, turned to an 'a posteriori' approach, calling upon statistical analysis to reorganize our model according to groupings that were supported by the data. Using such techniques as confirmatory analysis and principal component analysis, we were able to find the Scrum components that emerged from our data. It was then necessary to return to the literature, with this new perspective, to understand those newly defined constructs. This theory-free approach can be considered appropriate in areas where little theoretical basis has been established (Venkatraman, 1989) - as is the case with Scrum. The weakness of this approach is that, without theoretical understanding or meaning, the data analysis can raise more questions than it answers.

5.2.1 PRINCIPAL COMPONENT ANALYSIS

The Principal Component Analysis is an acceptable approach for new, unproven models, such as our newly hypothesized Scrum model (Venkatraman, 1989). As shown by figure 5.1, our principal component analysis presented 3 reliable measures from the fifteen (15) Scrum variables. We see that their Alphas are greater than 0.6, the acceptable lower limit for new measures.

Table 5.1 Scrum Principal Component Analysis

Scrum Variables	Component 1	Component 2	Component 3
	Client Involvement	Communication and Artifacts	Scrum Master Role
(Q1) Shippable features	**0.64**	0.37	0.10
(Q2) Available Product Owner	**0.87**	0.11	0.00
(Q3) Sprint Demonstration Meeting	0.34	**0.75**	-0.06
(Q5) Backlog Maintenance Meeting	0.22	**0.77**	0.30
(Q7) Sprint Backlog Artifact	0.02	**0.75**	0.19
(Q8) Product Backlog Artifact	0.32	**0.66**	0.36
(Q10) Sprints of 2 to 6 Weeks	0.09	**0.76**	-0.04
(Q11) Sprint Review Meeting	0.30	**0.65**	0.37
(Q12) Sprint Planning Meeting	0.08	**0.82**	0.22
(Q6) Scrum Master who Protects	0.42	0.19	**0.70**
(Q9) Scrum Master who enforces Process	0.56	0.32	**0.60**
Q13) Daily Scrum Meeting	-0.20	0.12	**0.80**
% VAR.	15.68	31.89	14.76

% CUMM. VAR.	47.57	31.89	62.33
CRONBACH ALPHA	0.65	0.90	0.69

Note: Factor loadings >0.595 are in boldface.

5.2.2 RESULTING SCRUM MODEL

Figure 5.1 below shows what the conceptual framework proved to be. Returning to the Scrum literature, we named these measures Scrum Master Role - as its variables describe the Scrum Master's main responsibilities, Client Involvement - as its variables describe the main functions of the Product Owner, and finally Communication and Artifacts - which was redefined and expanded to include all variables of documentation and meetings beyond those original included in this measure. Finally, three of our variables were left isolated: those of team size (Q4), multidisciplinary teams (Q14), and training (Q15), as they did not contribute to any one construct and simply added noise. We decided, however, to keep these variables individually as measures in the analysis to see if they each had any impact on creativity.

Figure 5.1 Redefined Scrum Model

5.3 DISCUSSION

As the constructs of the derived Scum model do not come from established theory, it is necessary to discuss and make some sense of these discovered measures - if they are to prove useful in supplementing our understanding. Nowhere in the literature are these activities explicitly named or identified, however, an interpretation of this grouping follows. This discussion is based upon the goals and definitions of the item as described in the literature, and is also based on the personal experience of the researcher; having applied these practices as a Certified Scrum Master for more than 6 years.

5.3.1 CLIENT INVOLVEMENT

The first construct groups the two activities of "Product Owner Involvement" in the project execution process, with the requirement from the Product Owner that "Shippable Features" be delivered at the end of iterations. Refer to as "Client Involvement", these two practices represent the key involvement of the client in the Scrum process. Unlike more traditional methodologies where the client may be most involved at the beginning of the project - defining scope, budget, and timelines, and then again involved at the end of the project - to take ownership of the deliverables, Scrum requires the client to be involved throughout the project. The Product Owner, or ultimate client, is expected to take part in meetings, contribute to artifacts, and play an active role as a participant in the execution of the project. The second item of "shippable features" is another key element of Scrum and the responsibility of the Product Owner. In Scrum, project progress is measured by the features that are completed and delivered - or "shippable", to be clear that the feature is really completed. The goal of Scrum's iterative delivery methodology is to ensure that during each iteration the team produces something shippable. It is the Product

Owner's responsibility to define and demand delivery of these features. One of the reasons why this cycle is so important is to get feedback from the ultimate users of those deliverable - as early as possible in the project. Making changes early in the project is usually much easier and less costly than the same changes later in the process. Therefore, if the Product Owner is involved in the execution of the project, requires shippable features after an iteration, and gathers feedback from end-users that uses these features early and regularly throughout the project, Scrum theory (Schwaber, 2004) states that the project is more likely to succeed.

As such, it is understandable that these two variables be correlated as a single construct; namely that of Client Involvement.

5.3.2 COMMUNICATION AND ARTIFACTS

The measure of Communication was originally defined as the set of meetings that are prescribed by the Scrum literature. However, as was presented in the analysis, this construct did not prove to be valid or reliable. In fact, the construct showed validity and reliability when the Daily Scrum Meeting was removed and the two artifacts - Product Backlog and Sprint Backlog - were added. The removal of the Daily Scrum meeting is discuss below. With the addition of the two backlogs, this construct becomes by far the largest of the model, representing half of all Scrum practices. It is somewhat surprising that the seven (7) variables that make up the measure do not form more granular groupings. Nonetheless, it can be hypothesized that Scrum is somewhat of an "all-or-nothing" kind of process, whereby the meetings, along with the artifacts, complement one another such that they must be performed together. The meetings are used to refine and clarify the artifacts, which feed into other meetings and back into other artifact. For example, the product backlog is kept up to date during the backlog maintenance meetings. THen the product backlog is used to drive the sprint planning meeting - where the team defines the sprint

backlog. Once executed, the sprint review meeting is used to refine the process, before once again returning to the sprint planning meeting. As such, it is again understandable that these meetings and artifacts be grouped as a single measure; namely Communication and Artifacts.

5.3.3 SCRUM MASTER ROLE

The last of the constructs is that of the Scrum Master Role. This construct is interesting in that it regroups the variables according to the actor - the Scrum Master - rather than according to the function (role, meeting, artifact) as originally expected. Here the three main responsibilities of the Scrum Master are grouped to form a valid and reliable measure. The Scrum Master is expected to be the main enforcer of the Scrum process - the roles, the meetings, the artifacts. The Scrum Master is expected to protect the team from interruptions during the sprint, when they are focussed and committed to delivering the features identified in the sprint backlog. Any interruptions, which can be frequent in any work environment, can undermine this effort that is at the root of the Scrum process. To accomplish these tasks, the Scrum Master must also enforce a Daily Scrum Meeting, whereby issues, interruptions, and problems can be addressed - and this on a daily basis. When the Scrum Master is performing these duties, and no problems go unaddressed for more than 24 hours, Scrum theory (Schwaber, 2004) states that a project is more likely to succeed. As such, it is again understandable that these variable correlate as to form a single construct; namely that of the Scrum Master Role.

5.4 SUMMARY

This Scrum Measurement Model was developed, refined, and validated in the context of this research project, not as an objective in an of itself (which would have been justifiable), but rather as a measurement tool necessary to answer the research question - measuring Scrum against creativity. This model remains a valuable base upon which to further measure and understand the effects of Scrum in other contexts. It is hoped that this new model will also prove useful in future studies; to be refined and extended.

CHAPTER VI

RESULTS AND ANALYSIS

Of our five-hundred (500) targeted participants, a total of two-hundred and thirteen (213) responded, for a response rate of forty-three percent (43%). A final one-hundred and seventeen (117) were found to be usable for analysis, after data-cleaning; removing ninety-six (96) incomplete or incoherent responses. We, therefore, base our analysis on the one-hundred and seventeen (117) data-points, representing fifty-five percent (55%) of all respondents, twenty-three percent (23%) of the targeted five-hundred (500) employee sample, and three percent (3%) of the organization's four-thousand (4000) employee population.

6.1 PARTICIPANT PROFILE

This section uses the profile section of the survey to provide a description of the 117 participants who's responses were retained for the analysis of this project.

6.1.1 LANGUAGE

The respondents were given the option to respond to the survey in either English or French. As shown in figure 6.1 below, approximately 60% responded in English and 40% in French:

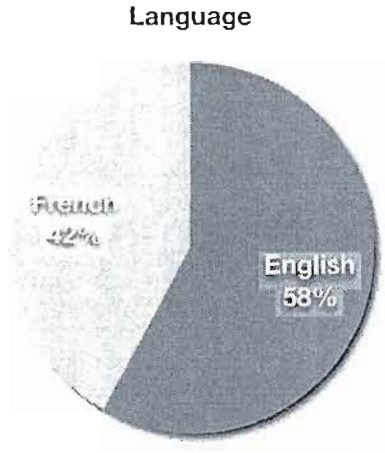


Figure 6.1 Respondents' Language

6.1.2 JOB GROUP

Entire project teams, and members from all disciplinary functions, were solicited to participate in the study. Only 5% of respondents held positions of project management, the remaining majority were members of project staff. Even though the questionnaire allowed participants to specify their job group from a list of more than fourteen (14) professions, there was insufficient numbers within each group to make more fine-grained analysis. Figure 6.2 below shows these results:

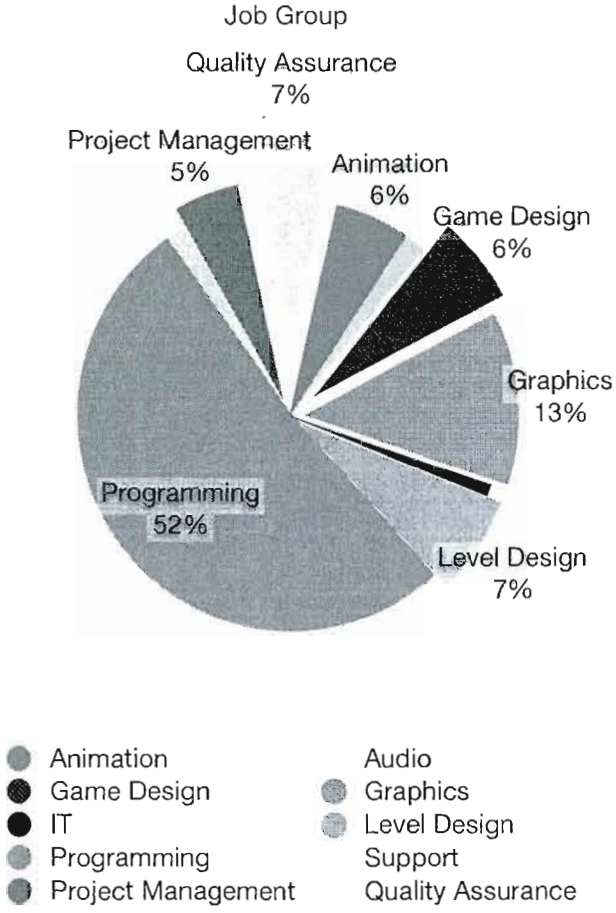


Figure 6.2 Respondents' Job Group

6.1.3 YEARS OF EXPERIENCE

Participants possessed a wide range of years of experience, from one (1) to twenty (20) years; the average being seven (7) years of experience. Figure 6.3 below shows the full spectrum:

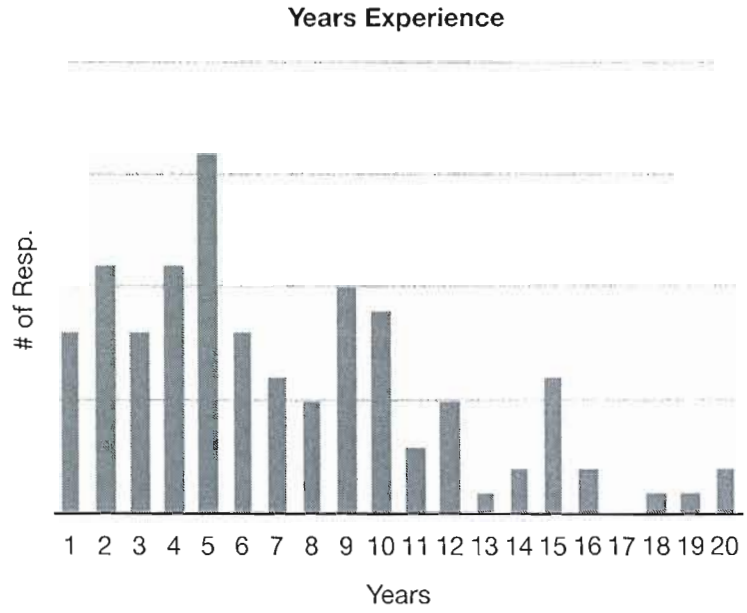


Figure 6.3 Respondents' Years of Experience

6.1.4 COUNTRY

Participants came from three principal countries: approximately 50% from Canada, and 25% from each of China and the United Kingdom. Figure 6.4 shows the detailed breakdown:

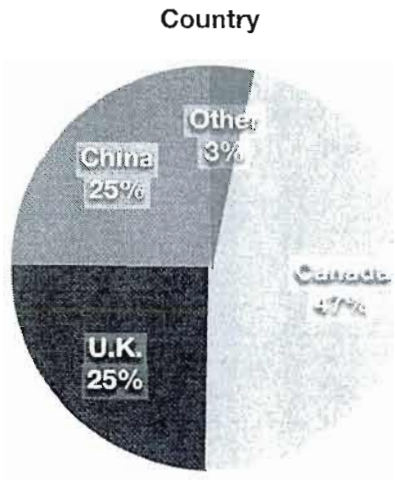


Figure 6.4 Respondents' Country

6.1.5 YEARS WITH THE ORGANIZATION

Participants had been with the case organization for an average of three (3) years, with as many as eleven (11) years. Figure 6.5 shows the details:

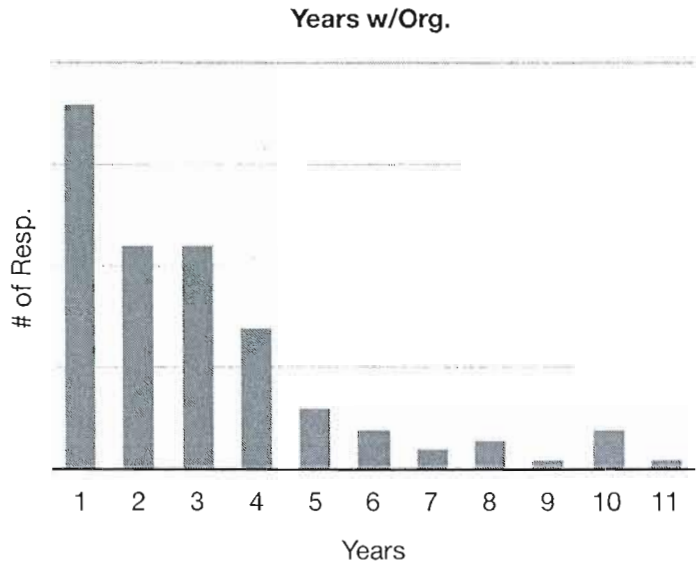


Figure 6.5 Years with the Organization

6.2 HYPOTHESES VERIFICATION

Our results verify our main hypothesis, as well as four out of five (4/5) of our sub-hypotheses. The main hypothesis is verified as Scrum is found to contribute positively to a creative work environment. The first sub-hypothesis is verified as Scrum contributes positively, with Client Involvement and Multidisciplinary Teams, to Freedom; even though Scrum Master shows a negative association. The second sub-hypothesis is verified, as Scrum contributes positively to Challenge with Client Involvement and Multidisciplinary Teams. The third sub-hypothesis is not verified, as Scrum is not found to contribute significantly to Work Group Support (Team). The fourth hypothesis is verified, as Scrum contributes positively, with Communication, to controlled Workload Pressure. Finally, our fifth sub-hypothesis is verified, as Scrum contributes positively to Creativity with Client Involvement and Multidisciplinary Teams. Table 6.1 summarizes these results.

Table 6.1 Hypotheses Verification

Hypotheses	Verified
H1: People who perceive a proper application of SCRUM project management practices will perceive their work environments as conducive to CREATIVITY.	✓
H1.1: People who perceive a proper application of SCRUM project management practices will perceive their work environments as providing FREEDOM.	✓
H1.2: People who perceive a proper application of SCRUM project management practices will perceive their work environments as providing CHALLENGING WORK.	✓
H1.3: People who perceive a proper application of SCRUM project management practices will perceive their work environments as providing WORK GROUP SUPPORT.	✗
H1.4: People who perceive a proper application of SCRUM project management practices will perceive their work environments as providing manageable WORKLOAD PRESSURE.	✓
H1.5: People who perceive a proper application of SCRUM project management practices will perceive their work environments as enabling personal CREATIVITY.	✓

6.2 ANALYSIS

We begin this section by justifying our method of analysis, and then delve into the statistical validation and analysis of our results.

6.2.2 MONO-METHOD

Each construct (Scrum, creativity) in our model was composed of approximately five (5) measures. Each measure has two parameters not directly accounted for in the model, namely the error (sigma) and the λ (lambda). Having two parameters per measure, and 5 measures per construct gives us 10 parameters per construct. Validity theory states that we should have a minimum of 5 and a maximum of 10 respondents per parameter in order to use the *mono-method* of data analysis (Hair et al., 1998). Five respondents times 10 parameters gives us a minimum of 50 respondents, and 10 respondents times 10 parameters gives us maximum of 100. As our sample gives us 117 usable respondents, we are very close to this targeted range and we therefore chose to use the mono-method to analyze our data.

Our other option would have been to perform a complete CFA (Confirmatory Factor Analysis). However, this method requires that we treat the entire model as a single construct, which, in the case of the creativity model, would give us 28 measures. Twenty-eight measures, each with 2 parameters, gives us 56 parameters. Our number of respondents would therefore need to fall within the range of a minimum 56 x 5 = 280 and a maximum of 56 x 10 = 560. Our sample of 117 falls far short of this requirement, so we therefore continued with the mono-method.

6.2.3 RELIABILITY

We used Cronback's Alpha (Cronbach, 1951) to test the internal consistency, or reliability, of our 5 measures of creativity and our 3 measures of Scrum. The purpose of this test is to show that the variables that make up each measure collectively account for a significant portion of that measures variation. If this is the case, then we establish that it is a good measure, and can therefore proceed with the analysis of inter-relationships between measures. Conversely, should this not be the case, then the measures would not be useable for further analysis.

Overall our results are satisfactory, with one measure of creativity - namely freedom - that showed weak, but acceptable, reliability. These results are presented below.

Creativity

The creativity measures were taken directly from the KEYS survey tool (Amabile, 1996). For the most part, these measures were reconfirmed as reliable measures; as their alphas each exceed 0.70. However, the measure of Freedom fell slightly short of this criteria, at 0.632. While this remains an acceptable value to be included in further analysis, we hypothesis an explanation for this result in our discussions of chapter seven.

Challenge = 0.759

Creativity = 0.881

Freedom = 0.632 (weak for an established model)

Team = 0.823

Workload = 0.723

Scrum

The Scrum measures, too, proved to be sufficiently reliable as the acceptable threshold falls to 0.60 for newly developed measures - such as our Scrum

model measures. These are particularly encouraging results, as they provide new direction for future studies of Scrum.

Communication = 0.900

Scrum Master = 0.690

Client Involvement = 0.652

With our measures proving to be reliable, we were able to continue our analysis. In the next section we discuss correlations between our measures.

6.2.4 CONVERGENT VALIDITY

The confirmatory factor analysis (mono-method) was used to confirm that the groupings of variables, into our measures (3 Scrum measures and 5 creativity measures), are indeed convergent (Venkatraman, 1989). Each variable is analyzed for its contribution to the total variation in the measure. As we will show in the following sections, all measure showed convergent validity. All measures proved to contribute significantly to their measure, and all fit indicators fell within acceptable ranges; namely (Hair et al., 1998):

- KHI / DF ≤ 3.00
- BENTLER-BONETT ≥ 0.90
- CFI ≥ 0.90
- IFI ≥ 0.90
- AGFI ≥ 0.90
- RMSEA ≤ 0.08

Therefore, no variables needed to be removed and no measure needed to be redefined.

6.2.4.1 CFA - CREATIVITY

Challenge

The challenge measure of the KEYS model (Amabile, 1996) is validated as all five variables are found to contribute significantly (table 6.2). However, it should be noted that the two of the variables (Q15, Q16) show weak contribution for an established model - suggesting that the challenge construct may not apply as well to the context in which this research takes place (video-game industry, international setting, etc.).

Table 6.2 Challenge - CFA

Challenge Variables	R	T
(Q9) Organization has urgent need for my work	**0.960** ****	4.261
(Q15) Important projects	**0.455** ****	4.754
(Q16) The best in me	**0.544** ****	5.796
(Q18) Challenged by work	**0.904** ****	10.068
(Q27) Challenging tasks	**0.736** ****	8.048
AVG R^2	0.557	
KHI^2	0.348	
DF	2	
P	0.840	
KHI /DF	0.174	
BENTLER-BONETT	0.998	
CFI	1	
IFI	1	
GFI	0.999	
AGFI	0.991	
RMSEA	0	

** $p \leq 0.10$, ** $p \leq 0.05$, *** $p \leq 0.01$, **** $p \leq 0.001$*

Creativity

The creativity measure of the KEYS model (Amabile, 1996) is validated as all six variables are found to contribute significantly (table 6.3).

Table 6.3 Creativity - CFA

Creativity Variables	R	T
(Q1) Trust among co-workers	**0.825** ****	10.025
(Q13) Great deal of creativity in daily work	**0.724** ****	8.764
(Q19) Environment for creativity of work group	**0.731** ****	8.831
(Q21) Environment for my own creativity	**0.868** ****	10.612
(Q23) Area of organization is innovative	**0.831** ****	10.038
(Q28) I am creative in my work	**0.674** ****	8.164

AVG R^2	0.606
KHI^2	5.770
DF	5
P	0.329
KHI /DF	1.154
BENTLER-BONETT	0.984
CFI	0.998
IFI	0.998
GFI	0.984
AGFI	0.934
RMSEA	0.037

** $p \leq 0.10$, ** $p \leq 0.05$, *** $p \leq 0.01$, **** $p \leq 0.001$*

Freedom

The freedom measure of the KEYS model (Amabile, 1996) is validated as all four variables are found to contribute significantly (table 6.4). However, it should be noted that, collectively, the variables account for only 0.345 of the measure; which is weak for an established model. This result suggests that the freedom construct, like the challenge construct, may not apply as well to the context in which this research takes place (video-game industry, international setting, etc.) and should be improved for future use.

Table 6.4 Freedom - CFA

Freedom Variables	R	T
(Q6) Sense of control over work and ideas	**0.519** ****	4.184
(Q7) Freedom to decide how to carry-out projects	**0.729** ****	4.588
(Q11) Freedom to choose projects	**0.602** ****	3.839
(Q20) Little pressure to meet others' specifications	**0.464** ****	3.903

AVG R^2	0.345
KHI^2	1.850
DF	1
P	0.174
KHI /DF	1.85
BENTLER-BONETT	0.964
CFI	0.981
IFI	0.983
GFI	0.992
AGFI	0.917
RMSEA	0.088

** $p \leq 0.10$, ** $p \leq 0.05$, *** $p \leq 0.01$, **** $p \leq 0.001$*

Team

The team measure of the KEYS model (Amabile, 1996) is validated as all eight variables are found to contribute significantly (table 6.5). However, like challenge, we find several variables (Q3, Q14, Q25) that show weak contribution to the model. This suggests that the team construct should be reviewed in this context.

Table 6.5 Team - CFA

Team Variables	R	T
(Q3) Work group open to new ideas	**0.544** ****	6.164
(Q4) Trust among colleagues	**0.917** ****	10.231
(Q8) People help each other within work group	**0.652** ****	6.848
(Q10) We make a good team	**0.695** ****	8.341
(Q12) Work group committed to our work	**0.741** ****	7.964
(Q14) Good blend of skills in work group	**0.497** ****	5.689
(Q17) Free and open communication	**0.675** ****	6.574
(Q25) Challenge each other's ideas	**0.548** ****	5.997
AVG R^2	0.450	
KHI^2	4.251	
DF	11	
P	0.962	
KHI /DF	0.38645	
BENTLER-BONETT	0.985	
CFI	1	
IFI	1	
GFI	0.991	
AGFI	0.97	
RMSEA	0	

** $p \leq 0.10$, ** $p \leq 0.05$, *** $p \leq 0.01$, **** $p \leq 0.001$*

Workload

The workload measure of the KEYS model (Amabile, 1996) is validated as all five variables are found to contribute significantly (table 6.6). However, three variables (Q2, Q5, Q26) show slightly weak contribution for an established model.

Table 6.6 Workload - CFA

Workload Variables	R	T
(Q2) Do not feel time pressure	**0.545** ****	4.387
(Q5) Not too many distractions	**0.561** ****	3.287
(Q22) Not too much work	**0.857** ****	7.402
(Q24) Sufficient time	**0.634** ****	6.049
(Q26) Not unrealistic expectations	**0.545** ****	5.346

AVG R^2	0.409
KHI^2	0.306
DF	1
P	0.580
KHI /DF	0.306
BENTLER-BONETT	0.997
CFI	1
IFI	1
GFI	0.999
AGFI	0.984
RMSEA	0

** $p \leq 0.10$, ** $p \leq 0.05$, *** $p \leq 0.01$, **** $p \leq 0.001$*

In the the next section, we present the confirmatory factor analysis for the Scrum model.

6.2.4.2 CFA - SCRUM

Below we present the results of the Scrum CFA. It should be noted that this analysis is somewhat redundant following the principal component analysis (PCA) presented in section 6.2.2. We present it here for reasons of consistency, following the same procedure as with our analysis of creativity. Essentially, the CFA is a complimentary method employed here to reconfirm the PCA.

Communication

The communication measure of the Scrum model is validated as all seven variables are found to contribute significantly (table 6.7).

Table 6.7 Communication - CFA

Communication Variables	R	T
(Q3) Sprint demonstration meeting	**0.754** ****	9.186
(Q5) Backlog maintenance meeting	**0.870** ****	11.329
(Q7) Sprint backlog artifact	**0.696** ****	7.995
(Q8) Product backlog artifact	**0.737** ****	8.848
(Q10) Sprints of 2 to 6 weeks	**0.626** ****	7.161
(Q11) Sprint review meeting	**0.728** ****	8.568
(Q12) Sprint planning meeting	**0.822** ****	10.416

AVG R^2	0.564
KHI^2	11.887
DF	12
P	0.455
KHI /DF	0.991
BENTLER-BONETT	0.973
CFI	1
IFI	1
GFI	0.972
AGFI	0.934
RMSEA	0

** $p \leq 0.10$, ** $p \leq 0.05$, *** $p \leq 0.01$, **** $p \leq 0.001$*

Client Involvement & Scrum Master

As it is not possible to perform a CFA on a construct that has only two items (in the case of Client Involvement), it was necessary to analyze the Client Involvement and Scrum Master measures together. The two measures are successfully validated in table 6.8. It should be noted that one variable (Q13) contributes weakly to the Scrum Master measure and could be reviewed in future research.

Table 6.8 Client Involvement & Scrum Master - CFA

Client Involvement Variables	R	T
(Q1) Potentially shippable features	**0.719** ****	6.769
(Q2) Product Owner who is available	**0.652** ****	6.253
Scrum Master Variables	R	T
(Q6) Scrum Master protects from interruptions	**0.723** ****	7.878
(Q9) Scrum Master ensures process	**0.960** ****	10.594
(Q13) Daily Scrum meeting	**0.312** ****	3.271
AVG R^2 (Client involvement)	0.471	
AVG R^2 (Scrum Master)	0.514	
KHI^2	2.676	
DF	3	
P	0.444	
KHI /DF	0.892	
BENTLER-BONETT	0.983	
CFI	1	
IFI	1	
GFI	0.991	
AGFI	0.955	
RMSEA	0	

** $p \leq 0.10$, ** $p \leq 0.05$, *** $p \leq 0.01$, **** $p \leq 0.001$*

6.2.5 DISCRIMINANT VALIDITY

The test for discriminant validity confirms that all measures are distinguishable from one another (discriminant) and that they do indeed converge as a single concept. In order to test the discriminant validity of our model, we followed the method described by Venkatraman (1989). As such, we first tested the correlation between each pair of measures with an unconstrained X^2 (CHI-Squared), and then retested with X^2 constrained to equal one (1). Should the difference between the models be significantly different (p-value less than 0.05) then we can conclude that the measures present discriminant validity.

The measures of our two concepts, Scrum and Creativity, are validated in the following sections.

6.2.5.1 DISCRIMINANT VALIDITY - CREATIVITY

The results from our study once again validate the discriminant validity of Amabile's (1996) KEYS model. The details of each measure are found below in table 6.9.

Table 6.9 Creativity Discriminant Validity

	Creativity				
	Estimated PHI	T	X^2 Unconstrained (DF)	X^2 Constrained (DF)	Diff.
Challenge with					
Creativity	0.651 ****	10.373	66.459 (36)	119.062 (37)	52.603 ****
Freedom	0.516 ****	5.146	36.029 (22)	60.533 (23)	24.504 ****
Team	0.328 ****	3.925	92.376 (52)	179.814 (53)	87.438 ****
Workload	0.075	0.825	37.010 (27)	106.189 (28)	69.179 ****
Creativity with					
Freedom	0.689 ****	9.128	41.543 (29)	57.887(30)	16.344 ****
Team	0.495 ****	7.013	85.619 (63)	222.547 (64)	136.928 ****
Workload	0.275 ****	2.894	30.999 (35)	97.225 (36)	66.226 ****
Freedom with					
Team	0.539 ****	5.900	55.837 (43)	78.449 (44)	22.612 ****
Workload	0.490 ****	4.378	51.420 (21)	72.891 (22)	21.471 ****
Team with					
Workload	0.370 ****	4.12	73.568 (51)	131.204 (52)	57.636 ****

** $p \leq 0.10$, ** $p \leq 0.05$, *** $p \leq 0.01$, **** $p \leq 0.001$*

6.2.5.2 DISCRIMINANT VALIDITY - SCRUM

Similarly, our Scrum model is validated, as each measure proves to be discriminant (table 6.10).

Table 6.10 Scrum Discriminant Validity

	Scrum				
	Estimated PHI	T	X^2 Unconstrained (DF)	X^2 Constrained (DF)	Diff.
Communication with					
Client	0.583 ****	5.899	49.015 (24)	67.470 (25)	18.455 ****
Scrum Mstr	0.679 ****	10.496	55.527 (32)	106.330 (33)	50.803 ****
Client with					
Scrum Mstr	0.672 ****	7.253	2.676 (3)	14.782 (4)	12.106 ****

** $p \leq 0.10$, ** $p \leq 0.05$, *** $p \leq 0.01$, **** $p \leq 0.001$*

6.2.5.3 DISCRIMINANT VALIDITY - SCRUM vs. CREATIVITY

Finally, we cross-validate all measures together and find that no two measures are indistinguishable for one another.

Table 6.11 Scrum vs. Creativity Discriminant Validity

Scrum vs. Creativity					
	Estimated PHI	T	X^2 Unconstrained (DF)	X^2 Constrained (DF)	Diff.
Communication with					
Challenge	0.194 **	2.186	64.970 (48)	181.422 (49)	116.452 ****
Creativity	0.181 **	1.932	74.505 (58)	348.494 (59)	273.989 ****
Freedom	0.239 **	2.115	37.085 (40)	73.460 (41)	36.375 ****
Team	0.122 *	1.327	87.073 (78)	299.802 (79)	212.729 ****
Workload	0.272 ***	2.682	40.114 (47)	110.562 (48)	70.448 ****
Client with					
Challenge	0.521 ****	5.604	6.713 (10)	26.523 (11)	19.81 ****
Creativity	0.404 ****	3.997	16.366 (15)	40.973 (16)	24.607 ****
Freedom	0.439 ****	3.265	10.776 (7)	27.749 (8)	16.973 ****
Team	0.199 **	1.774	37.963 (25)	67.311 (26)	29.348 ****
Workload	0.218 **	1.821	7.255 (9)	35.249 (10)	27.994 ****
Scrum Master with					
Challenge	0.275 ****	3.545	12.328 (16)	96.191 (17)	83.863 ****
Creativity	0.164 **	1.662	28.298 (22)	115.655 (23)	87.357 ****
Freedom	-0.037	-0.321	20.449 (12)	114.025 (13)	93.576 ****
Team	0.056	0.595	39.325 (34)	126.627 (35)	87.302 ****
Workload	0.123	1.139	12.040 (15)	96.686 (16)	84.646 ****

** $p \leq 0.10$, ** $p \leq 0.05$, *** $p \leq 0.01$, **** $p \leq 0.001$*

With our measures proven to be reliable and valid, we aggregate each by calculating the averages of its items. We continue in the next sections to reveal the correlations and contributions between the measures - and reveal the key findings of this research.

6.2.6 CORRELATION MATRIX AND DESCRIPTIVE STATISTICS

We used a correlation matrix to verify that none of the independent variable were too strongly correlated with one another ($\leq$0.50 correlation). Two of our constructs, namely Communication and Scrum Master, did present a relatively strong correlation (0.56) in this uni-variable test, but nonetheless proved to be valid in the discriminant validity. The full correlation matrix is presented in appendix C.

6.2.7 REGRESSION MODEL

Our regression model analysis unveils ten (10) significant contributions between Scrum practices and the components of a creative work environment. Client involvement in the Scrum process stands out as the most significant element, being correlated with four (4) components of creativity. Next we found that multidisciplinary teams in Scrum relates significantly to three (3) elements of creativity. Finally, the Scrum Master role, teams of 5 to 9 member, and standard communication practices each contribute to single (1) components of the creativity model.

Figure 6.6 below provides a overview of the relationships, and we will presents the details in the following sections.

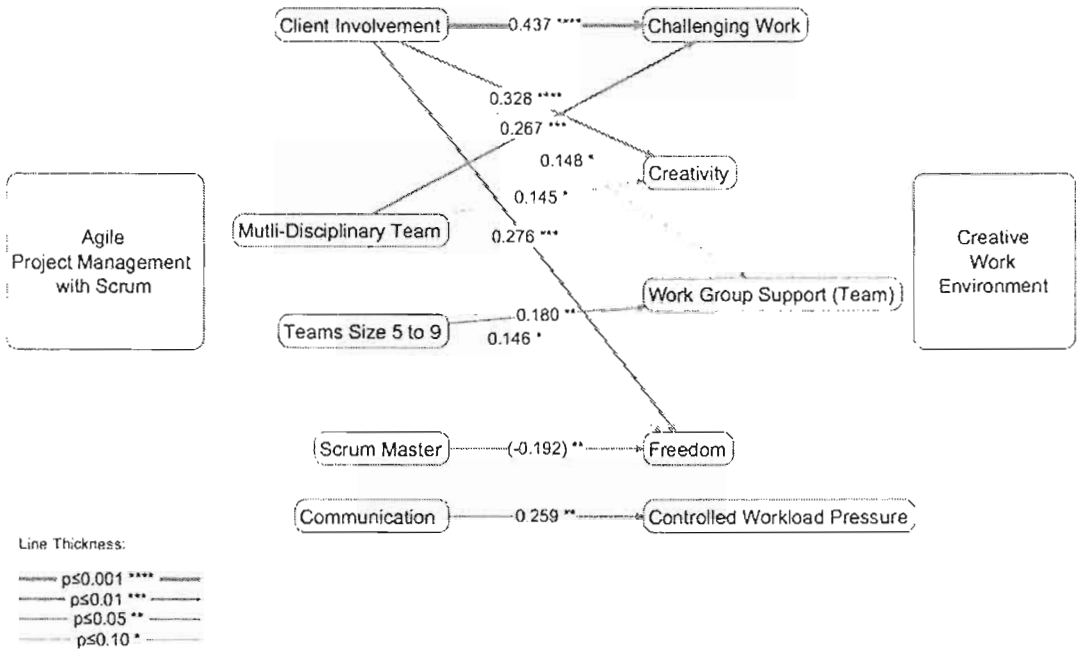


Figure 6.6 Regression Model Overview

In the next sections, we present the regression analysis of each of our Creativity constructs. We present the standardized beta as a measure of contribution, the T-value ($\geq$2 for 0.05 significance), and the VIF as a measure of collinearity ($\leq$ 3 for insignificance).

6.2.7.1 CHALLENGE

We find in table 6.12 that Client (beta=0.437 ****) and Scrum Q14 (beta=0.267 ***) are positively associated with Challenge - Client being the more determinant. Furthermore, the model explains 21.8% **** (adjusted R^2) of the variance. This will prove to be a key finding of this research and is detailed in our discussion of chapter six.

Table 6.12 Challenge Regression

Scrum Items	Standardized Beta	T	Collinearity VIF
Client	**0.437** ****	4.502	1.360
Multidisciplinary Team (Q14)	**0.267** ***	3.082	1.081
Communication	-0.033	-0.289	1.863
Scrum Master	-0.013	-0.130	1.530
Team 5-9 (Q4)	-0.048	-0.557	1.079
Scrum Training (Q15)	-0.053	-0.546	1.342
R^2	0.259		
Adjusted R^2	**0.218** ****		

*One-Tail Test: * p≤0.10, ** p≤0.05, *** p≤0.01, **** p≤0.001*

6.2.7.2 CREATIVITY

Next, we find in table 6.13 that, again, Client (beta=0.328 ****) and Scrum Q14 (beta=0.145 *) are the items that associate positively with our dependent variable - in this case Creativity. Client remains the more determinant. Overall, the model explains 8.6% ** (adjusted R^2) of the variance. It is interesting to see how client involvement and multidisciplinary teams again prove to relate to creativity; not only at the work environment level, but also at the personal creativity level.

Table 6.13 Creativity Regression

Scrum Items	Standardized Beta	T	Collinearity VIF
Client	**0.328** ****	3.126	1.360
Multidisciplinary Team (Q14)	**0.145** *	1.548	1.081
Communication	-0.117	-0.950	1.863
Scrum Master	0.012	0.109	1.530
Team 5-9 (Q4)	0.102	1.089	1.079
Scrum Training (Q15)	0.056	0.534	1.342
R^2	0.134		
Adjusted R^2	**0.086** **		

*One-Tail Test: * $p \leq 0.10$, ** $p \leq 0.05$, *** $p \leq 0.01$, **** $p \leq 0.001$*

6.2.7.3 FREEDOM

Here we find that Client (beta=0.276 ***) and Scrum Q14 (beta=0.146 *) are positively associated with Freedom. Surprisingly - another key finding of this research - Scrum Master (beta= - 0.192 **) is found to be negatively associated with Freedom. We explore these findings later in our discussion. The model explains 9.4% *** (adjusted R^2) of the variance, with Client as the most determinant. Table 6.14 provides the details below.

Table 6.14 Freedom Regression

Scrum Items	Standardized Beta	T	Collinearity VIF
Client	**0.276** ***	2.643	1.360
Scrum Master	**-0.192** **	-1.733	1.530
Multidisciplinary Team (Q14)	**0.146** *	1.567	1.081
Communication	0.101	0.828	1.863
Team 5-9 (Q4)	0.101	1.083	1.079
Scrum Training (Q15)	0.047	0.458	1.342
R^2	0.143		
Adjusted R^2	**0.094** ***		

*One-Tail Test: * $p \leq 0.10$, ** $p \leq 0.05$, *** $p \leq 0.01$, **** $p \leq 0.001$*

6.2.7.4 TEAM

We find in table 6.15 that Scrum Q4 (beta=0.180 **) and Client (beta=0.148 *) are positively associated with Team - Scrum Q4 being the more determinant. However, the overall contribution of 3.5% (adjusted R^2) is not significant with a P=0.13 (>0.10). Table 6.15 provides the detailed statistics.

Table 6.15 Team Regression

Scrum Items	Standardized Beta	T	Collinearity VIF
Team 5-9 (Q4)	**0.180** **	1.871	1.079
Client	**0.148** *	1.374	1.360
Communication	0.044	0.353	1.863
Scrum Master	-0.073	-0.635	1.530
Multidisciplinary Team (Q14)	0.04	0.415	1.081
Scrum Training (Q15)	0.111	1.035	1.342
R^2	0.087		
Adjusted R^2	0.035		

*One-Tail Test: * $p \leq 0.10$, ** $p \leq 0.05$, *** $p \leq 0.01$, **** $p \leq 0.001$*

6.2.7.5 WORKLOAD

Lastly, we find that Communication (beta=0.259 **) is positively associated with Workload. Overall, the model explains 4.2% * (adjusted R^2) of the variance. Table 6.16 presents the details. As we discuss in the next chapter, these results support some of the claims found in Scrum literature.

Table 6.16 Workload Regression

Scrum Items	Standardized Beta	T	Collinearity VIF
Communication	**0.259** **	2.066	1.873
Client	0.061	0.563	1.374
Scrum Master	-0.116	-1.026	1.521
Team 5-9 (Q4)	0.036	0.378	1.078
Multidisciplinary Team (Q14)	0.106	1.12	1.069
Scrum Training (Q15)	0.022	0.209	1.349
R^2	0.092		
Adjusted R^2	**0.042** *		

*One-Tail Test: * $p \leq 0.10$, ** $p \leq 0.05$, *** $p \leq 0.01$, **** $p \leq 0.001$*

6.2.7.6 REGRESSION SUMMARY

Table 6.17 below provides a summary of the regression analysis, highlighting the contributions of our Scrum measures on those of a creative work environment.

Table 6.17 Regression Summary

Scrum	Contribution	**Creativity**
Client Involvement	****	Challenge
	****	Creativity
	***	Freedom
Multidisciplinary Team	***	Challenge
	*	Creativity
	*	Freedom
Communication	**	Workload
Team Size 5-9	*	Team
Scrum Master Role	(**)	Freedom

*One-Tail Test: * $p \leq 0.10$, ** $p \leq 0.05$, *** $p \leq 0.01$, **** $p \leq 0.001$*

CHAPTER VII

DISCUSSION

From the results shown in chapter six, several of our findings merit further discussion - namely, our Scrum measurement model, client involvement, the Scrum Master role, multidisciplinary teams, and communication and artifacts in Scrum.

7.1 SCRUM MEASUREMENT MODEL

This research contributes a reliable and valid measurement model to the field of Scrum project management. Three constructs, namely Client Involvement, Scrum Master Role, and Communication and Artifacts are developed, as well as the individual item of Multidisciplinary Teams. Drawn from the literature, validated with Scrum professionals, and proven with empirical data, this model takes a first step towards a Scrum measurement tool to be used in future research projects.

7.2 CLIENT INVOLVEMENT

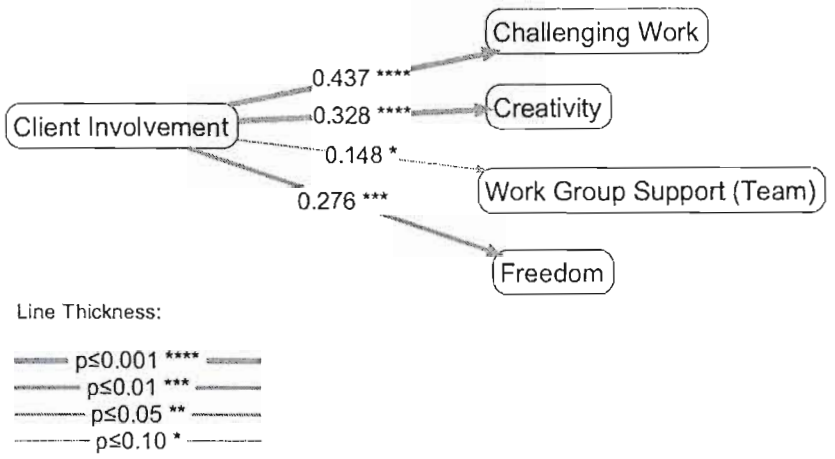


Figure 7.1 Client vs. Creativity

Figure 7.1 above recalls the results from chapter five whereby Client Involvement was found to be significantly correlated with four (4) of the creativity measures. Client involvement implies several things. Firstly, Scrum prescribes a more continuous and permanent participation of the client (Product Owner) in the project process. Traditionally, this involvement may not be required or expected. Furthermore, rather than the hierarchical communication flow that may flows from the client to the project manager, and from the project manager to the team, in fact it could be advantageous to have more of a star typology in our projects. This would mean that the three roles could interact more freely (see figure 7.2). The results suggest that direct contact with the client gives the team the outlet to express their creativity. Being able to discuss options and alternatives directly with the client helps may ensure that team members use their personal and collective creativity. Team members seem to work better together, motivated by client involvement, as we see a

heightened sense of work group support. Furthermore, this openness to discussion ensures that members find challenge in their tasks, having worked through the best possible solutions. As long as this discussion remains open, and the client consistently informs the team of "what" is important, without necessarily requiring "how" the work be performed or implemented, the team maintains a degree of freedom that is important to a creative work environment. Finally, client involvement implies that the Product Owner enforce and demand that "potentially shippable" features be delivered at the end of the sprints. This essential practice of Scrum project management ensures that the project shows progress - progress that is measured in completed features. Furthermore, if the client uses these deliveries to gather feedback from end-users, then the project benefits from early and frequent corrects to any issues that arise. As per Scrum theory (Schwaber, 2004), these practices contribute to project success.

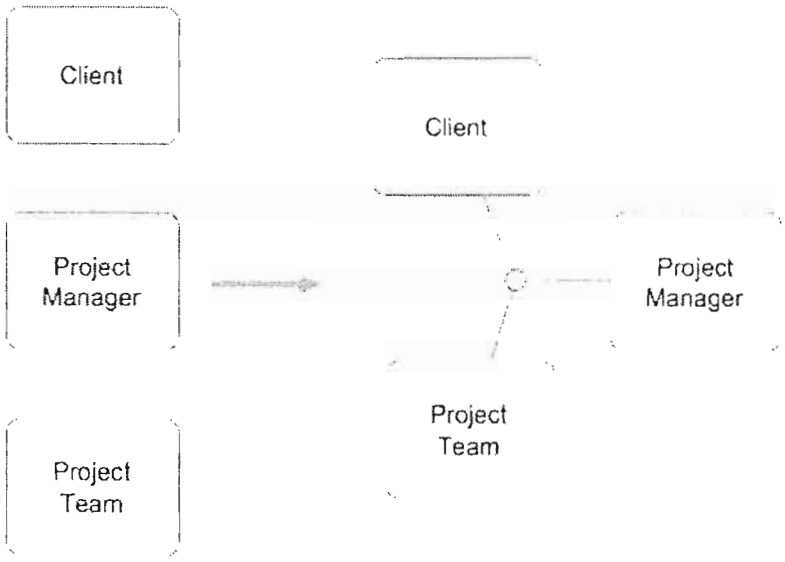


Figure 7.2 Client Involvement

It is important to consider that, even though these findings come from a study on Scrum, it is fathomable that this practice be employed outside of the Scrum framework. These are, after all, project management practices, and as such might be seen as tools for any project or project manager. In their book, Dinsmore and Cooke-Davis (2006) recommend just such an approach of "constant client involvement rather than management-by-plan". As this suggests, it can be imagined that in some cases, traditional project management practices that do not involve the client in project execution, succeed in delivering the project to plan, but fail to meet the client's requirements. Traditional measures of project progress and success are often defined by the plan; a plan that is defined at the beginning of the project, and may not remain entirely accurate or relevant as the project context changes. Scrum attempts to remedy this situation by measuring progress by the actual use of the progressively developed features. But this process requires the participation of the client.

In the next section, we continue our analysis with the role of the Scrum Master.

7.3 SCRUM MASTER

The most surprising result of our study shows a negative correlation between the basic Scrum Master practices and Freedom of creativity (figure 6.3).

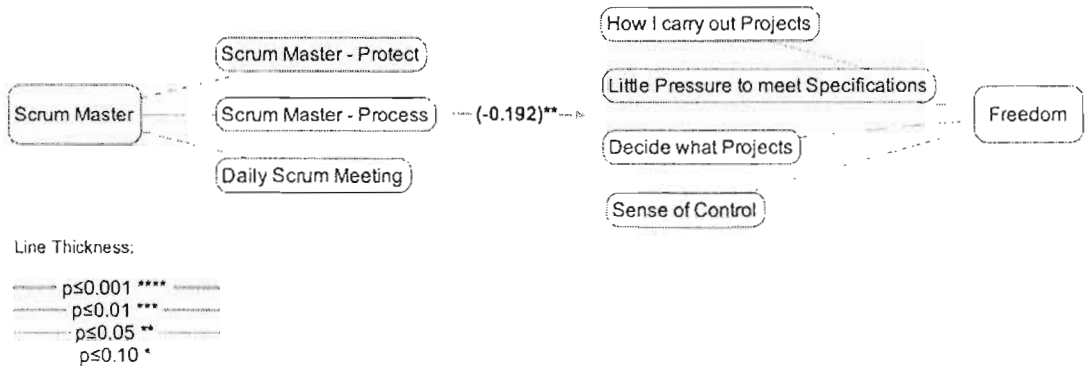


Figure 7.3 Scrum vs. Freedom

It would seem that, even in Scrum, the role of the project manager (Scrum Master) is perceived as somehow controlling, and robs the team of freedom. This result is possibly the most surprising because it contradicts the literature. The Scrum Master role is thought to bring a "light touch" management style - one of facilitation and collaboration. This negative correlation is more what we would expect from more traditional project management roles - roles that are often characterized by "command and control" stereotypes that we expect to crush creativity with standardization and conformity.

It should be noted, however, how our statistical analysis (Cronbach's Alpha) found a somewhat weak reliability of the freedom measure, showing that our variables did not capture as much of the measure as we would have expected from such and

established model. Perhaps with a stronger measure of freedom the results would have been different. We hypothesize that the Freedom measure, as defined by Amabile (1996) may not apply as well to the video-game industry, and that it may need to be modified to better capture "freedom" as it is understood in this industry and "projectized" culture.

Lastly, we draw attention to the fact that one of the questions of the Freedom construct is worded in the negative: "I feel little pressure to meet someone else's specifications in how I do my work." Our fear here is that perhaps this question was consistently misinterpreted, resulting in the negative correlation. Consequently, this result would merit further research.

7.4 MULTIDISCIPLINARY TEAMS

The cross-domain discussions that are created by a multidisciplinary team appears to add to the perception of challenging work. Perhaps team members appreciate the opportunity to learn about other disciplines, and make their own contributions. A better understand of how one's tasks can effect, and be effected by, others' tasks can broaden our perspective and add challenge. Perhaps this increased challenge also calls for increased creativity, as we search for global, rather than local, solutions. Referring to figure 6.4 below, we also see an increased perception of freedom. We suggest that a work setting that facilitates the discussion, debate, and decision-making activities across disciplines has a positive impact on the team's sense of freedom to choose and define its work. Many positive benefits come into play when team members are asked to contribution and share both within and beyond the barriers of their discipline.

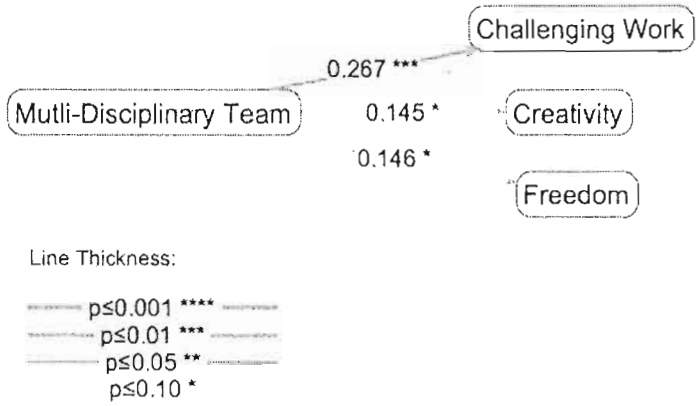


Figure 7.4 Multidisciplinary Teams

It is again encouraging to note that this practice of forming multidisciplinary teams within the project can be considered among the practices of any project. One need not follow Agile or Scrum, necessarily, to use it. These results suggest the value of using multidisciplinary team as a tool in project management.

7.5 COMMUNICATION AND ARTIFACTS

We are very surprised by the results of Scrum communication. We are not so much surprised by the results themselves - but rather by the lack of results. We found communication to be positively related to the control of workload pressure (see figure 7.5). This is consistent with the literature, as a sustainable work pace is one of the proclaimed goals and benefits of Agile and Scrum. We are, however, surprised that this is the only significant result found for the communication construct. The communication measure groups half of the Scrum practices (7 practices). As such, we would have expected that this measure would appear in a significant portion of the results. This is not of course not the case. This does not speak to whether or not

Scrum is effective as a project management methodology, but does suggest that a large portion of the Scrum practices have little or no relation to a work environment that is conducive to creativity.

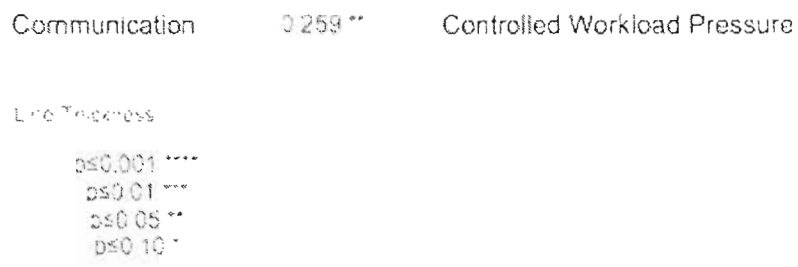


Figure 7.5 Communication and Artifacts

Unlike the previous results, the practices regrouped by the communication measure cannot easily be implemented within just any project. These practices are more specifically Scrum, and as such would be difficult to apply with a traditional project process. These practices are meant to replace - and not coexist - with their traditional project management counterparts. For example, communicating project scope through a high level product backlog - that evolves and changes with every iteration does not marry well with a linear approach of project initiation, planning, execution and closure. Similarly, having team members define their own tasks at the beginning of each iteration does not lend itself well to the top-down decision-making structure of a traditional project hierarchy. Nonetheless, reviewing traditional practices in light of Scrum can provide perspective and inspire change where change is required, even if the Scrum practices are not adopted completely. For example, the continuous planning and re-planning inherent in Scrum, demonstrated in the product backlog that is constantly being updated, might inspire practitioners to reevaluate the rigidity of project plans that is often associated with traditional projects - at least when the project context demands such agility.

CHAPTER VIII

CONCLUSION

8.1 KEY FINDINGS

In conclusion, our results stress the importance of measurement tools, like the Scrum model we developed in this project. Without such tools, we cannot measure the concepts at play in our projects, nor can we test our hypotheses. These tools provide an important base upon which to better our understanding.

Our findings stress the importance of client involvement in our projects. The client ultimately defines the project that the team must deliver. Bridging the gap between the two parties seems to be an important enabler of ideas and creativity.

The role of the Scrum Master as defined in the literature is brought into question. Rather than being a role of facilitation and empowerment, our findings suggest that the Scrum Master may in fact limit the freedom of the project team. And freedom is thought to be an important element of a creative work environment.

Finally, we find that multidisciplinary teams contributes to several aspects of creativity - most significantly to the level of challenge perceived in project work. It can be inferred that, when a team is composed of several professions and backgrounds, the exchange and complement of knowledge challenges workers with considerations beyond their individual domains.

We continue in the next section with a look at the limitations of our research.

8.2 LIMITATIONS

These results are promising in that they suggest interesting possibilities and tools for further study. However, the results from this single study, within a single company, from 100 respondents, cannot be considered generalizable - and, as such, these results remain exploratory.

We also recall the nature of the case company. A leader in the video-game development industry, creativity is a daily mantra within its walls. Not only do they seek efficiency, quality, and innovation - much like any other industry - but they are required to deliver "fun" with every project. This more often than not obliges them to delivery radical innovation, rather than simply incremental innovation. Furthermore, this radical innovation is often required from multiple domains at the same time - from graphic technology, audio technology, story writing, voice acting, etc. Few other projects, and other industries, are held to this same standard. As such, it can be said that the case company has a culture of creativity- that must be considered when evaluating the application of these results.

Lastly, we must recall that participation in the survey was not obligatory and remained anonymous. Those 117 participants who chose to respond were not a random sample. The fact that they came from projects using Scrum, and that they chose to respond to the survey, necessarily characterizes them as those who have something to say - and in some way were motivated by this study on Scrum and creativity. This bias must also be considered when reviewing the results.

8.3 FUTURE RESEARCH

This research represents a single step, hopefully among many others to come, in the desire to evolve and improve our project practices. In this section we stress the need for further research - both on this topic of Agile and innovation, and on the field of project management in general.

There is much interest in the understanding of Agile project management, and Scrum. In this study we have proposed the beginnings of a measurement tool. We defined the variables according to the current literature, and used statistical analysis to extract and define the Scrum model. This technique was appropriate for our exploratory study, but speaks to the immaturity of the field. This model is a good starting point, from which to identify potential paths towards theory, but it now must to be refined, retested, and revalidated before it can expose generalizable results.

We reused and revalidated the Keys model (Amabile, 1996) for measuring creativity. However, our results showed weaknesses in the model when applied to our research context. This suggests that the model could be refined to better understand these weaknesses.

The results show much potential in this single company and single industry study. The next step must be to expand the study to a larger scale, perhaps in a multi-company and multi-industry context. Many are interested in improving their project management practices. Many are interested in driving innovation in their products, services, and internal processes. Many would participate in such studies. And many would benefit from the results. With continued collaboration between academic and

practicing project management professionals, we can achieve great things in project management.

8.4 CONCLUSION

We set out to answer our research question, with the objective of gaining a better understanding of project management. To this end, we are successful - our findings do indeed show how Agile project management practices are conducive to a creative work environment.

We chose to explorer the relatively recent methodology of Agile project management with Scrum. We hypothesized that a link between Scrum project management practices and a work environment that is conducive to creativity might help explain the popularity (if not success) and potential of this "new age" project management style.

What we found was much deeper. We did not merely find relationships between Scrum and a creative work environment, we found practices that effect individual components of creativity. These practices do not exclusively belong to Scrum or Agile, but can more generally be seen as project management practices. Whether you be "traditional" or "Agile", "waterfall" or "iterative", these results can benefit us all.

On the side of creativity, we can again say that the results are deeper than expected. We found that individual components of a creative work environment, like challenging work and a sense of freedom to contribute, can be impacted by our project management practices. While it is of great value to know that these components are collectively important to foster a creative work environment, this research also incites the recognition and evaluation of their individual benefits as well.

This project has contributed to the project management and creativity bodies of knowledge in three important ways. Firstly, we validated the KEYS model (Amabile, 1996). We did, however, challenge the variable of Challenge and the measure of Freedom - and their validity in the context of the international video-game industry. Secondly, we took a first step towards the creation of a tool for measuring Scrum project management practices. Finally, we present quantitative, empirical evidence of the correlation between Scrum project management practices and a work environment that is conducive to creativity.

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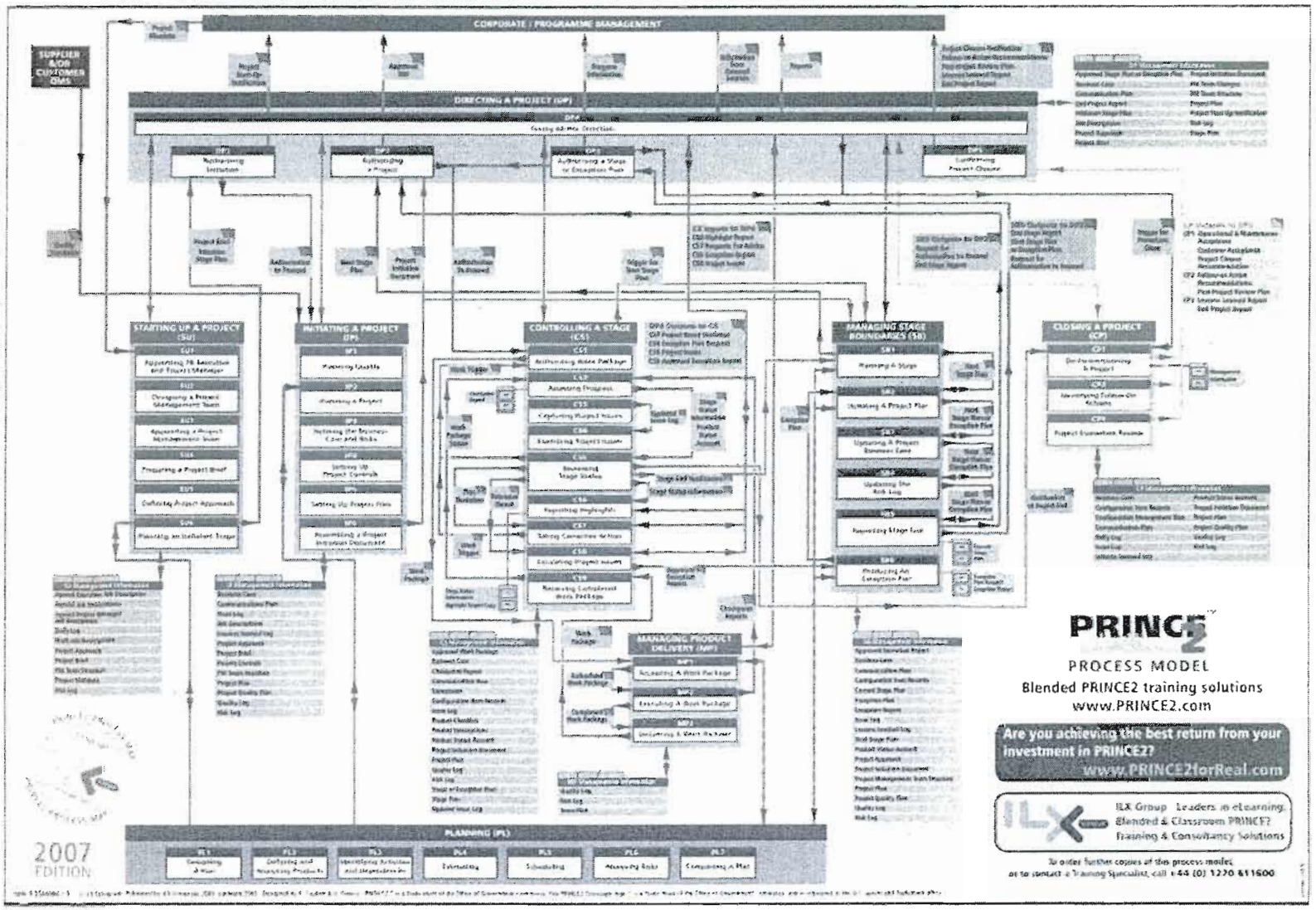
APPENDICES

APPENDIX A - PROJECTS IN CONTROLLED ENVIRONMENTS

(Internet site: www.prince2.com accessed November 25, 2008)


CORPORATE | PROGRAMME MANAGEMENT
SUPPLIER &/OR CUSTOMER ENVS
DIRECTING A PROJECT (DP)
STARTING UP A PROJECT (SU)
INITIATING A PROJECT (IP)
CONTROLLING A STAGE (CS)
MANAGING STAGE BOUNDARIES (SB)
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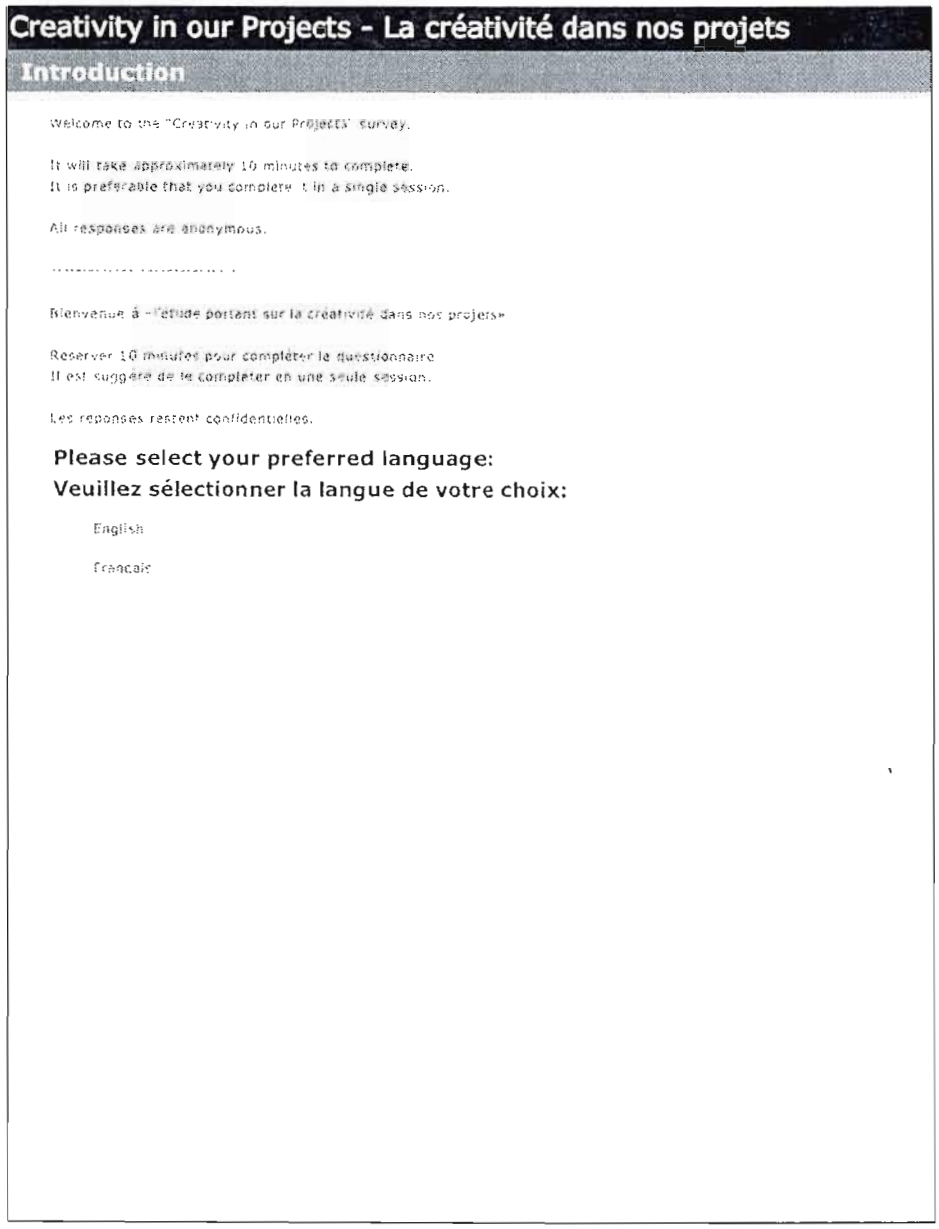
APPENDIX B - SURVEY

Internet-based Data Capture System

INTRODUCTION (bilingual)



Creativity in our Projects - La créativité dans nos projets

Introduction

Welcome to the "Creativity in our Projects" survey.

It will take approximately 10 minutes to complete.
It is preferable that you complete it in a single session.

All responses are anonymous.

Bienvenue à « l'étude portant sur la créativité dans nos projets »

Réserver 10 minutes pour compléter le questionnaire.
Il est suggéré de le compléter en une seule session.

Les réponses restent confidentielles.

Please select your preferred language:
Veuillez sélectionner la langue de votre choix:

English

Français

PROFILE (English)

Creativity in our Projects - La créativité dans nos projets

Profile

* What is your job group?

- Animation
- Audio
- Creative direction
- Game Design
- General Management
- Graphics
- HR
- IT
- Level Design
- Playtest
- Programming
- Production Support
- Project Management
- Quality Assurance/Control
- Other (please specify)

How many years of experience do you have?

* In what studio do you work?

For how many years have you worked at Ubisoft?

CREATIVITY I (English)

Creativity in our Projects - La créativité dans nos projets

Survey

Creativity

A.

	Always	Often	Sometimes	Never
1. My AREA of this organization IS CREATIVE.				
2. I do NOT feel a sense of TIME PRESSURE in my work.				
3. People in my work group are OPEN TO new IDEAS.				
4. There is a feeling of TRUST among the people I work with most closely.				
5. There are NOT too MANY DISTRACTIONS from project work in this organization.				
6. In my daily work environment, I feel a SENSE OF CONTROL over my own work and my own ideas.				
7. I have the freedom to decide how I am going to CARRY OUT my PROJECTS				
8. In my work group, people are willing to HELP EACH OTHER.				
9. The ORGANIZATION has an urgent NEED for successful completion of the work I am now doing.				
10. My co-workers and I make a GOOD TEAM.				

B.

	Always	Often	Sometimes	Never
11. I have the freedom to DECIDE WHAT PROJECT(s) I am going to do.				
12. The people in my work group are COMMITTED to our work.				
13. A GREAT deal of CREATIVITY is called for in my daily work.				
14. There is a good BLEND OF SKILLS in my work group.				
15. I feel that I am working on IMPORTANT PROJECTS.				
16. The tasks in my work call out THE BEST IN ME.				
17. There is free and OPEN COMMUNICATION within my work group.				
18. I feel CHALLENGED by the WORK I am currently doing.				
19. Overall, my current work environment is conducive to the CREATIVITY of my work GROUP.				
20. I feel little PRESSURE to meet someone else's specifications in how I do my work.				

Creativity II (English)

Creativity in our Projects - La créativité dans nos projets

C.

	Always	Often	Sometimes	Never
21. Overall, my current work environment is conducive to MY OWN CREATIVITY.				
22. I do NOT have too MUCH WORK to do in too little time.				
23. My AREA of this organization IS INNOVATIVE.				
24. I have SUFFICIENT TIME to do my project(s).				
25. Within my work group, we CHALLENGE each other's IDEAS in a constructive way.				
26. There are NOT UNREALISTIC EXPECTATIONS for what people can achieve in this organization.				
27. The TASKS in my work are CHALLENGING.				
28. I believe that I AM currently very CREATIVE in my work.				

* Do you use Scrum at Ubisoft?

Yes

No

SCRUM (English)

Creativity in our Projects - La créativité dans nos projets

Survey

Scrum

	Always	Often	Sometimes	Never
1. My team produces potentially SHIPPABLE features EACH SPRINT				
2. We have a Product Owner who is AVAILABLE when he/she is needed.				
3. My team holds a SPRINT DEMONSTRATION meetings at the end of each sprint.				
4. My team consists of 5 to 9 people				
5. My team holds regular product BACKLOG MAINTENANCE meetings to keep the product backlog up to date.				
6. My team has a Scrum Master who PROTECTS the team from INTERRUPTIONS during the sprint				
7. My team maintains a SPRINT BACKLOG of work in progress.				
8. My team maintains a PRODUCT BACKLOG of prioritized requirements				
9. My team has a Scrum Master who makes the team and Product Owner follow the SCRUM PROCESS.				
10. My team uses sprints that are a consistent length and between 2 and 6 weeks long.				
11. My team holds a sprint REVIEW/LESSONS LEARNED meeting at the end of each sprint.				
12. My team holds a SPRINT PLANNING meeting at the beginning of each sprint.				
13. I participate in DAILY SCRUM meetings of 15 minutes each.				
14. My team is MULTI-DISCIPLINARY having members from various disciplines and professions.				
15. My team receives SUFFICIENT Scrum TRAINING.				

What are your impressions of Scrum?

PROFILE (French)

Creativity in our Projects - La créativité dans nos projets

Profile

* Votre poste se rattache à :

- Animation
- Audio
- Direction créative
- Game Design
- Management
- Graphiques
- RH
- TI
- Level Design
- Playtest
- Programmation
- Support à la production
- Gestion de projet
- Assurance qualité
- Autre (spécifier)

Combien d'années d'expérience détenez-vous ?

* Dans quel studio travaillez-vous ?

Depuis combien d'années êtes-vous à l'emploi d'Ubisoft ?

CREATIVITY I (French)

Creativity in our Projects - La créativité dans nos projets

Questionnaire

La Créativité

A.

Toujours Souvent Quelquefois Jamais

1. Mon équipe est CRÉATIVE.
2. Je ne sens PAS de PRESSION DE TEMPS dans mon travail
3. Les membres de mon equipes sont OUVERTS a de nouvelles IDÉES.
4. Il y a un esprit de CONFIANCE dans mon equipe.
5. Dans notre organisation, il n'y a PAS trop de DISTRACTIONS pendant le travail.
6. Dans mon quotidien, j'ai un SENTIMENT de CONTRÔLE sur mon travail et mes idées.
7. J'ai la liberte de décider comment je vais ACCOMPLIR mes TÂCHES.
8. Dans mon equipe, NOUS nous S'ENTRE-AIDONS les uns les autres.
9. Mon TRAVAIL est INDISPENSABLE à l'organization.
10. Mes collegues et moi formons une BONNE ÉQUIPE.

B.

Toujours Souvent Quelquefois Jamais

11. J'ai la liberte de CHOISIR LES PROJETS sur lesquels je travaille.
12. Les membres de mon equipe se DÉDIENT a notre travail.
13. Mon travail demande BEAUCOUP de CRÉATIVITÉ.
14. Les individues de mon équipe détiennent des CONNAISSANCES COMPLÉMENTAIRES
15. J'ai le sentiment de travailler sur des PROJETS IMPORTANTS.
16. Mes taches me force à faire de MON MIEUX.
17. La COMMUNICATION se fait de manière OUVERTE dans mon équipe.
18. Mon TRAVAIL me fait vivre des défis STIMULANTS.
19. En general, mon environnement de travail est propice à la CRÉATIVITÉ de mon ÉQUIPE.
20. Je ressens peu de PRESSION pour respecter les spécification d'autrui.

CREATIVITY II (French)

Creativity in our Projects - La créativité dans nos projets

C.

TouJoursSouventQuelquefoisJamais

21. En général, mon environnement de travail est propice à MA CREATIVITE.

22. Je n'ai PAS TROP de TRAVAIL à faire en trop peu de temps

23. Mon équipe est INNOVATRICE.

24. J'ai SUFFISAMMENT de TEMPS pour faire mon projet.

25. Dans mon équipe, nous QUESTIONNONS mutuellement nos IDÉES de manière constructive.

26. Il n'y a PAS d'ATTENTES IRRÉALISTES sur ce que les gens doivent accomplir dans notre organisation

27. Mes TÂCHES me donne un CHALLENGE (défi).

28. En ce moment, je pense ÊTRE CREATIF dans mon travail.

*** Utilisez-vous le Scrum chez Ubisoft ?**

Oui

Non

SCRUM (French)

Creativity in our Projects - La créativité dans nos projets

Questionnaire

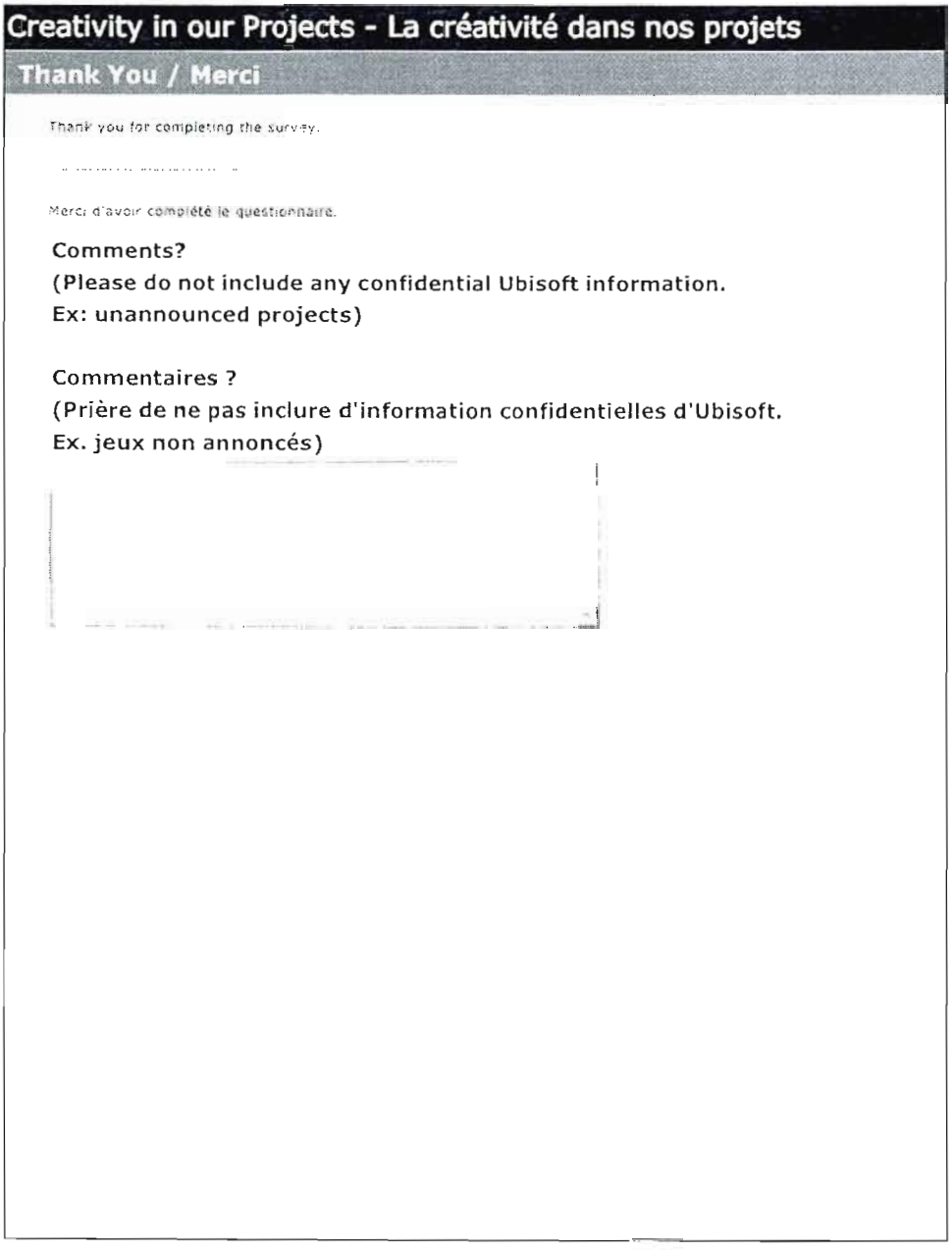
Scrum

TOUJOURSSOUVENTQUELQUEFOISJAMAIS

1. Mon équipe produit des features COMPLETES avec chaque sprint.
2. Nous avons un « product owner» DISPONIBLE au besoin.
3. Mon équipe fait une PRÉSENTATION du travail complété à la fin de chaque sprint.
4. Mon équipe est compose de 5 à 9 membres.
5. Mon équipe se réunit RÉGULIÉREMENT pour maintenir le «product backlog» à jour.
6. Mon équipe a un «Scrum-master» qui PROTÈGE l'équipe contre les INTERRUPTIONS pendant le «sprint».
7. Mon équipe maintient un «SPRINT BACKLOG» du travail en cours.
8. Mon équipe maintient un «PRODUCT BACKLOG» de besoins selon leurs priorités.
9. Mon équipe a un «Scrum-master» qui OBLIGE l'équipe et le «Product owner» à suivre le PROCESSUS Scrum.
10. Dans mon équipe, nous faisons des sprints d'une durée continue de 2 à 6 semaines.
11. Mon équipe fait une réunion RETROSPECTIVE à la fin de chaque sprint.
12. Mon équipe participe à une réunion de «SPRINT PLANNING» au début de chaque sprint.
13. Je participe à des réunions QUOTIDIENNES de Scrum de 15 minutes.
14. Mon équipe est MULTI-DISCIPLINAIRE et regroup des gens de différents métiers
15. Mon équipe reçoit une FORMATION Scrum suffisante.

Quelles sont vos impressions sur Scrum ?

THANK YOU (bilingual)



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Thank You / Merci

Thank you for completing the survey.

Merci d'avoir complété le questionnaire.

Comments?
(Please do not include any confidential Ubisoft information.
Ex: unannounced projects)

Commentaires ?
(Prière de ne pas inclure d'information confidentielles d'Ubisoft.
Ex. jeux non annoncés)

APPENDIX C - CORRELATION MATRIX

Correlation Matrix

	Challenge	P	Creativity	P	Freedom	P	Team	P	Workload	P	Comm.	P	Client	P	Scrum Mstr.	P	Scrum Q4	P	Scrum Q14	P	Scrum Q15
Challenge	1.00																				
Creativity	0.68	0.00	1.00																		
Freedom	0.35	0.00	0.49	0.00	1.00																
Team	0.47	0.00	0.54	0.00	0.43	0.00	1.00														
Workload	0.18	0.05	0.28	0.00	0.39	0.00	0.40	0.00	1.00												
Comm.	0.20	0.03	0.14	0.12	0.22	0.02	0.17	0.06	0.27	0.00	1.00										
Client	0.43	0.00	0.34	0.00	0.31	0.00	0.21	0.02	0.17	0.06	0.49	0.00	1.00								
Scrum Mstr.	0.15	0.10	0.14	0.13	0.04	0.68	0.08	0.40	0.09	0.36	0.56	0.00	0.40	0.00	1.00						
Scrum Q4	-0.04	0.68	0.10	0.27	0.13	0.16	0.19	0.05	0.10	0.29	0.26	0.01	0.03	0.72	0.14	0.14	1.00				
Scrum Q14	0.31	0.00	0.18	0.06	0.19	0.05	0.07	0.44	0.15	0.10	0.20	0.03	0.12	0.21	0.13	0.17	0.02	0.83	1.00		
Scrum Q15	0.13	0.18	0.18	0.06	0.18	0.06	0.21	0.03	0.15	0.10	0.45	0.00	0.35	0.00	0.40	0.00	0.09	0.36	0.22	0.02	1.00
Mean	2.37		2.74		2.86		1.86		2.97		2.30		2.60		2.36		1.85		2.73		2.68
Std. Dev.	0.82		0.94		0.78		0.61		0.84		1.12		1.10		1.14		1.36		1.49		1.36