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Impact of the Journey: IS Employee Attitudes and Perceptions as Organizations Climb the CMM Ladder

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IMPACT OF THE JOURNEY: IS EMPLOYEE ATTITUDES AND PERCEPTIONS AS ORGANIZATIONS CLIMB THE CMM LADDER

L'impact du voyage : Les attitudes et les perceptions des employés des DSI lorsque les organisations gravissent les échelons du CMM

Completed Research Paper

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Abstract

We surveyed 736 IS professionals in organizations at varying levels of the Capability Maturity Model (CMM) to investigate job attitudes and perceptions. Although anecdotal reports and the scant preliminary empirical studies to-date suggest job attitudes and perceptions improve for employees as organizations climb the CMM ladder, we found evidence of a more complex picture. IS workers reported significantly lower professional efficacy and affective commitment in organizations at CMM Level 3 than in organizations at Level 1, and reports of cynicism were higher in organizations at upper levels of the CMM.

Keywords: CMM, software process improvement, job satisfaction, affective commitment, role conflict, role ambiguity, work overload, cynicism, professional efficacy, IS professionals

Résumé

Nous avons interrogé 736 professionnels des technologies dans des organisations ayant différents niveaux de CMM pour enquêter sur leurs attitudes et perceptions professionnelles. L'image obtenue est plus complexe qu'une simple amélioration de ces attitudes et perceptions avec l'augmentation du niveau atteint. Les employés des DSI montrent une efficacité professionnelle et un engagement affectif significativement plus bas au niveau 3 de CMM qu'à niveau 1, ainsi qu'un accroissement du cynisme avec un niveau élevé de CMM.

Introduction

In this study, we surveyed IS (information systems) professionals in organizations at varying levels of the Capability Maturity Model (CMM) to investigate job attitudes and perceptions. The literature to-date generally implies that job attitudes and perceptions improve for employees as organizations climb the CMM ladder, although clear empirical evidence has not been reported. In this introductory section, we provide a brief description of the Capability Maturity Model, followed by a review of the literature regarding employee attitudes and the CMM. The remainder of the paper reports our research methods and findings.

The Capability Maturity Model (CMM)

In 1986, in response to reports of software development projects exceeding budget, missing targeted completion dates, and failing to meet client specifications, the U.S. government requested a method to assess the capabilities of potential software development contractors. Large contract overruns compelled the federal government to more accurately predict the project quality and efficiency of potential vendors, and private-sector counterparts outsourcing software development experienced this need as well. The Software Engineering Institute (SEI) and Massachusetts Institute of Technology Research and Engineering (MITRE) Corporation responded by commencing development of a process maturity framework. The intent of the framework was to help organizations improve their software development and maintenance processes in order to meet the functionality needs of their clients on time and within budget.

Over the next several years, the framework evolved from a description of software process maturity (Humphrey and Sweet, 1987) to the first version of the Software Capability Maturity Model (Paulk, Curtis, and Chrissis, 1991) and version 1.1 (Paulk, Curtis, Chrissis, and Weber, 1993). In 2002, the Capability Maturity Model - Integrated (CMMI) v1.1 was introduced to consolidate the Software Capability Maturity Model (SW-CMM), the Systems Engineering Capability Model, and the Integrated Product Development Capability Maturity Model (SEI CMMI Product Team, 2002). Version 1.2 of the CMMI was released in August, 2006. Data for the present research was collected during 2003 and 2004, when few companies had made decisions to move from the SW-CMM to the CMMI. Thus, the participating companies included in this research were those that had achieved levels associated with the SW-CMM, also referred to simply as the CMM.

The Software Capability Maturity Model (CMM) is composed of five levels of organizational maturity. The five levels are presented in Table 1.

Table 1. Five Levels of the CMM

Maturity Level	*Description of Each Maturity Level*
(1) Initial	Software process is characterized as ad hoc, occasionally chaotic. Success is dependent upon heroic efforts.
(2) Repeatable	Basic project management processes are established to track costs, schedule adherence, and functionality. Process discipline is in place to repeat earlier successes on similar projects.
(3) Defined	Software process for both management and engineering activities is documented, standardized, and integrated into a standard software process across the organization. All projects use an approved, tailored version of the organization's standard software process for developing and maintaining software.
(4) Managed	Detailed measures of the software process and product quality are collected. Both the software process and products are quantitatively understood and controlled.
(5) Optimizing	Continuous process improvement is enabled by quantitative feedback from the process and from piloting innovative ideas and technologies.

Each maturity level in the CMM is a distinct stage that describes a level of process capability. For example, Level 2 is focused on implementing project management practices and controls to achieve repeatability. Within each

maturity level is a set of Key Process Areas (KPAs) (Paulk, Curtis, et.al. 1993). KPAs for the maturity levels are shown inside the boxes in Figure 1.

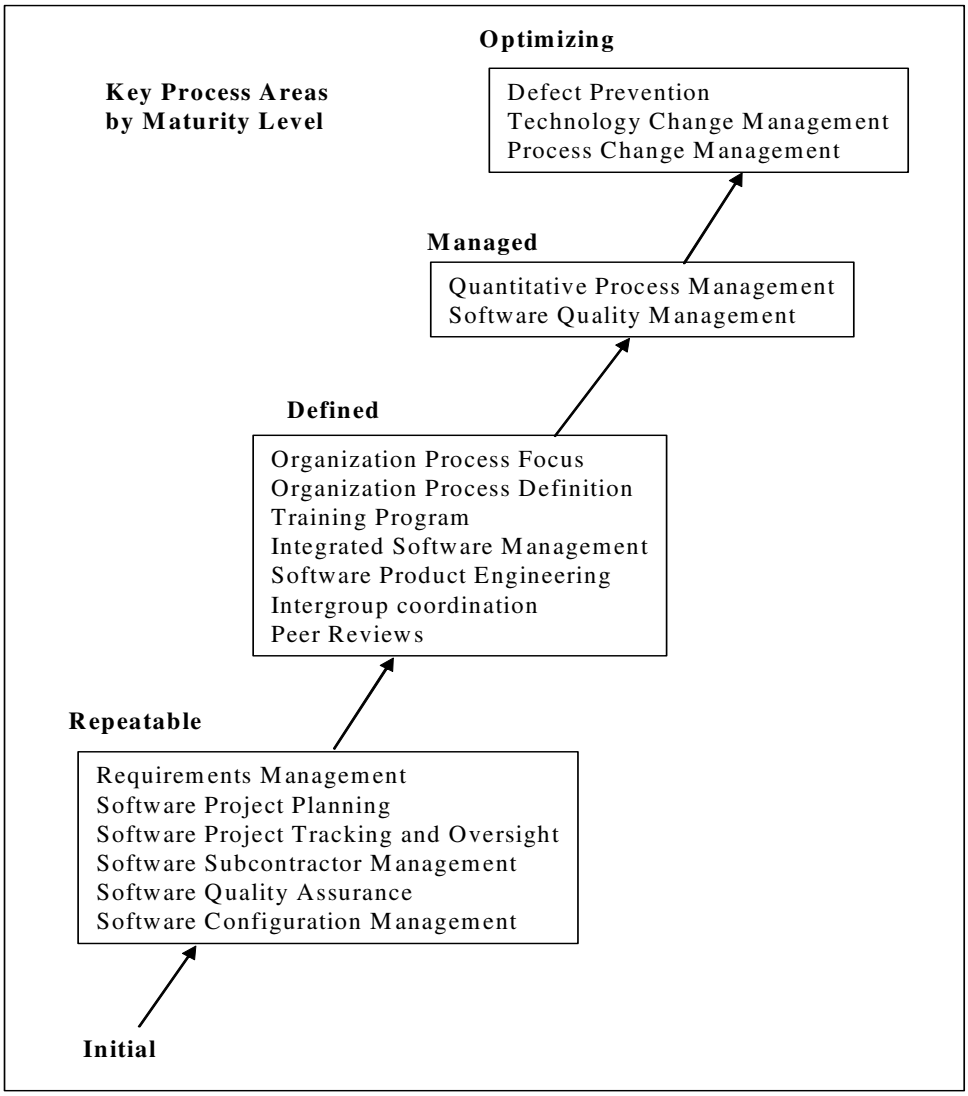

Figure 1. Key Process Areas by Maturity Level

Each KPA encompasses a set of Key Practices that are grouped into five Common Features. The Common Features represented in each KPA are: Activities Performed; Commitment to Perform; Ability to Perform; Measurement & Analysis; and Verifying Implementation. The Key Practices for each Common Feature will vary by KPA.

To illustrate the CMM structure, consider organizational maturity Level 3 (Defined). As shown in Figure 1, one KPA at this level is Organization Process Focus. An example of a Key Practice within each of the Common Features for Organization Process Focus follows (Paulk, Curtis, et.al., 1993):

> *Activity Performed 1:* The software process is assessed periodically, and action plans are developed to address the assessment findings.
>
> *Commitment to Perform 1:* The organization follows a written organizational policy for coordinating software process development and improvement activities across the organization.
>
> *Ability to Perform 1:* A group that is responsible for the organization's software process activities exists.

Measurement & Analysis 1: Measurements are made and used to determine the status of the organization's process development and improvement activities.

Verifying Implementation 1: The activities for software process development are reviewed with senior management on a periodic basis.

Given this understanding of the CMM framework, including the concept of Key Practices undertaken by employees to achieve levels of the CMM, we next consider the research literature regarding outcomes associated with organizational initiatives to reach higher levels of the CMM.

Moving Up the CMM Ladder: Employee Attitudes and Perceptions

Corporate initiatives to move up in the levels of the CMM are common, as companies seek to improve the efficiency and effectiveness of development efforts. Frequently cited benefits associated with CMM software process improvement initiatives are: defect reduction and identifying defects earlier in the development process where it is less costly to correct them (Diaz & Sligo, 1997; Dion, 1993; Haley, 1996; Pitterman, 2000; Wohlend & Rosenbaum, 1994); productivity improvements, such as number of lines of code per staff month (Diaz & Sligo, 1997; Dion, 1993; Haley, 1996; Wohlend & Rosenbaum, 1994); cycle reduction time or reducing the time to market (Diaz & Sligo, 1997; Wohlend & Rosenbaum, 1994); cost and schedule predictability (Brodman & Johnson, 1995; Dion, 1993; Haley, 1996; Pitterman, 2000; Wohlend & Rosenbaum, 1994); and customer satisfaction (Pitterman, 2000; Wohlend & Rosenbaum, 1994).

While these business measures are important when considering the benefits of the CMM, a critical area that has been under-emphasized in the literature is the impact of CMM on the individual worker. Several publications mention higher job satisfaction, improved employee morale, less overtime, and reduced turnover as intangible or secondary benefits to be gained through CMM initiatives, but in nearly all cases the remarks are anecdotal (Paulk, Curtis, et al. 1993; Brodman and Johnson, 1995; Dion, 1993; and Humphrey, Snyder, & Willis, 1991). Our research turned up only three empirical studies, which we discuss in turn.

Yamamura and Wigle (1997) of Boeing Defense and Space Group examined employee satisfaction at three intervals: before beginning process improvement activities, midway through the activities, and after the activities were concluded. Employee satisfaction was assessed by a single-item measure using a scale of 1 to 10, with 1 being "highly dissatisfied" and 10 being "extremely satisfied." They found that prior to the process improvement activities, the average employee satisfaction score was 5.7, with 26 percent of the employees expressing some level of dissatisfaction. Midway through the process improvement activities, the average employee satisfaction score had increased to 7.5. After achieving CMM Level 5, employee satisfaction reached 8.3.

In the organization that Yamamura and Wigle (1997) studied, the CMM framework had not been applied until the Level 5 assessment was made. It is unclear whether the organization would be considered Level 1 or 2 or 3 or 4 when the "before" and "midway" measures were taken. While the study generally suggests that employee satisfaction improves as an organization rises in CMM level, further research is needed due to: the use of a general conceptualization of employee satisfaction that was not explicitly defined; the problematic nature of a single-item measure; and the inability to demarcate satisfaction at CMM levels between 1 and 5.

Hyde and Wilson (2004) searched for evidence of improved "intangible" benefits in an organization recently assessed at CMM Level 2. Software professionals completed a survey in which they were asked to indicate their extent of agreement with statements such as: Less stress/pressure; Fewer overtime hours; Improved morale. It is unclear how the items were introduced – whether the respondent was asked to relate back to a particular point in time, or was asked to compare present conditions to how things were prior to attainment of Level 2, or was provided some other framing. Results are a bit difficult to interpret because means and standard deviations are not reported; instead, a bar chart of responses is presented for each item. Based on the bar charts, the authors indicate that the average response to "Fewer overtime hours" was mostly agreement. However, the average responses for "Less stress/pressure" and "Improved morale" appear to be neutral (rather than leaning toward agreement or disagreement). While this study captures employee perceptions at CMM Level 2, the authors encourage further study to determine the extent of improvement at Level 3, noting that anecdotal reports from SEI suggest many benefits are not realized until an organization reaches that level. Future studies should also draw upon existing work in job attitudes and perceptions from the management and IS disciplines and utilize multiple-item scales or other established methods to assess the constructs and report results.

Finally, Herbsleb, Zubrow, Goldenson, Hayes, and Paulk (1997) utilized an SEI database of CMM appraisal results to identify organizations to survey regarding a number of performance dimensions. They attempted to survey 167 individuals representing 61 assessments and received usable data for 138 of those individuals (it is not clear how many assessments were represented in the final sample). Of the 138 participants in the sample, 47 were senior members of technical staff, 47 were project managers, and 44 were members of an SEPG (software engineering process group). Among the performance dimensions investigated was "Staff morale." The percentage of respondents in this sample reporting that their organization had "excellent" or "good" staff morale at Level 1 was slightly more than 20%. At Level 3 and above, the percentage rose to 60%. While this certainly suggests an increase in morale as organizations climb the CMM ladder, some aspects of the study are unclear. The number of organizations and assessments represented in the results and the number of respondents representing each organization or assessment are not reported. Also, the authors acknowledge that the grouping of "excellent" and "good" into a percentage to be compared across CMM levels may be problematic. It is unclear why the scale (excellent, good, fair, poor) was not analyzed as an interval scale and reported and tested by group means (respondents grouped by Level 1, Level 2, and Level 3 and above).

Taken together, the three empirical studies of employee attitudes and perceptions at varying levels of the CMM reveal methodological issues (in construct definition and measurement, and in sampling and comparison of results by CMM level) along with a few contrary findings. Whereas results from Yamamura and Wigle (1997) and Herbsleb and his colleagues (1997) tend to support anecdotal reports of improved job satisfaction and morale as organizations climb the CMM ladder, Hyde and Wilson (2004) found a "neutral" average response from employees regarding improved employee morale and reduced stress and pressure. Given these issues and contradictory findings from the scant prior research and our understanding of Key Practices being implemented as organizations progress up the CMM levels, we believe the experience of the IS professional during a CMM initiative may be more intricate than the literature to-date implies. In a recent consideration of challenges associated with managing process change in software organizations, Qin (2007, p. 429) recognized:

> "… the process users – are busier than ever before. For example, software project teams are always under pressure of balancing the schedule, budget, and quality of a software delivery… In addition, the benefits of process change almost inevitably reside with the business owners – employees still work the same hours everyday and remain as busy as they were prior to the improved process, though with the extra burden of retraining and infringements upon their comfort zones."

Moitra (1998) maintains that most organizations, while emphasizing the need for improvement in the software development process, almost completely ignore people-related processes. Similarly, in viewing people issues associated with process improvement at Oerlikdon Aerospace, Laporte and Trudel (1998, p. 195) were convinced that the success or failure of an improvement program "has more to do with managing the human aspect than managing the technical aspect." And Baddoo and Hall (2002) maintain that while human factors within process improvement are emerging as important in achieving matured processes, they continue to be neglected.

We know from the management literature that employee perceptions and job attitudes demand attention in modern organizations. A recent meta-analysis determined that employee attitudes – job satisfaction and organizational commitment – predict important work behaviors related to performance and job engagement (Harrison, Newman, & Roth, 2006). Harrison and his colleagues concluded that positive job attitudes lead employees to "contribute rather than withhold desirable inputs from their work roles" (Harrison, et al., 2006: p. 320).

Our Study

Given the importance of job attitudes and the paucity of rigorous research on employee attitudes associated with CMM initiatives, our study investigates the research question: *Does the "CMM journey" impact job attitudes and perceptions of IS professionals and, if so, in what ways?*

Because anecdotal reports from the SEI suggest that many benefits are not realized until an organization reaches CMM Level 3 (Hyde & Wilson, 2004), job attitudes and perceptions at CMM Level 1 and at Level 3 and beyond are of particular interest in our study. To achieve an in-depth examination of job satisfaction, we utilize an established multi-dimensional measure of satisfaction. We also examine job perceptions (e.g., role conflict and perceived workload) relevant to IS professionals, as well as ones that arise from the CMM anecdotal literature (e.g., cynicism). And to gauge employee morale, we assess affective commitment reported by IS professionals in organizations at different levels of the CMM.

In the sections that follow, we develop hypotheses regarding specific job attitudes and perceptions of IS professionals relative to CMM Levels, and then describe methods associated with our data collection. After presenting results, we discuss the findings along with implications for practice and future research.

Hypotheses

To examine the IS professional's experience in the CMM journey, we focus on job attitudes and perceptions that are particularly salient to IS professionals and those that are reflected in the CMM anecdotal literature. Prior research shows role conflict, role ambiguity, and work overload are especially germane to IS workers. Role conflict is the perception of inconsistent or incompatible job expectations, whereas role ambiguity represents confusion regarding the definition and expectations of the job (Nelson and Quick, 2003). Both role conflict and ambiguity have been shown to be present for IS professionals over the years (e.g., Goldstein and Rockhart, 1984; Li and Shani, 1991). Work overload is another recurring theme in studies of IS professionals (e.g., Bartol and Martin, 1982; Li and Shani, 1991; Moore, 2000).

Role conflict is expected to be higher for IS professionals at CMM Level 1 – characterized as ad hoc and sometimes chaotic – than for IS professionals in organizations at CMM Level 3 and higher. Role conflict was apparent in the case study of a CMM Level 2 organization (Hyde and Wilson, 2004: p. 226) where many software professionals became disenchanted "when caught between managers driving process adherence and customers questioning the value and perceived overhead." However, Key Practices associated with CMM Level 3 and higher reflect organization-level order and coordination, as well as periodic review of software process improvement activities. These practices include (Paulk, Weber, Garcia, Chrissis, and Bush, 1993):

- The organization's and projects' activities for developing and improving their software processes are coordinated at the organization level. [Organization Process Focus Activity 3]
- The activities for software process development and improvement are reviewed with senior management on a periodic basis. [Organization Process Focus Verification 1]

Such practices at CMM Level 3 and beyond should act to reduce role conflict, leading us to extend the following hypothesis:

> *Hypothesis 1: Role conflict reported by IS professionals in CMM Level 1 organizations is significantly higher than that reported by IS professionals in organizations at CMM Level 3 and above.*

Role ambiguity also is expected to be higher for IS professionals in the ad hoc, occasionally chaotic CMM Level 1 organization than for IS workers in organizations at CMM Level 3 and higher. Stelzer and Mellis (1998) maintain that organizations tend to underestimate the change management aspect of process improvement initiatives, noting that software teams frequently experience uncertainty and disruption when beginning the efforts (McGrath, 1996). Moitra (1998) also describes individuals experiencing uncertainty in organizations climbing the CMM ladder. Organizations reaching CMM Level 3 and beyond, however, have generally implemented Key Practices that should alleviate confusion regarding job expectations and how to meet those expectations, such as (Paulk, Weber, et al., 1993):

- Members of the software engineering group and other software-related groups receive orientation on the organization's software process activities and their roles in those activities. [Organization Process Focus Ability 4]
- The groups involved in implementing the software processes are informed of the organization's and projects' activities for software process development and improvement. [Organization Process Focus Activity 7]
- A library of software process-related documentation is established and maintained. [Organization Process Definition Activity 6]

We therefore extend the following hypothesis regarding role ambiguity:

> *Hypothesis 2: Role ambiguity reported by IS professionals in CMM Level 1 organizations is significantly higher than that reported by IS professionals in organizations at CMM Level 3 and above.*

Work overload is expected to be higher for IS professionals at CMM Level 1 than for IS professionals in organizations at CMM Level 3 and higher. In their case study of a single organization, Hyde and Wilson (2004)

found that survey respondents mostly agreed that they experienced fewer overtime hours in their organization at CMM Level 2. Humphrey et al. (1991) examined a process improvement initiative undertaken by the Software Engineering Division at Hughes Aircraft and found that overtime hours were reduced as the organization moved from CMM Level 2 to Level 3. Similarly, Dion (1993) reported that software engineers in Raytheon's Equipment Division were spending fewer late nights and weekends on the job, once Level 3 process maturity was achieved. Key Practices associated with CMM Level 3 and higher that likely contribute to lower perceptions of work overload include practices related to general management and structured testing (Paulk, Weber, et al., 1993):

- The software managers receive training in managing the technical, administrative, and personnel aspects of the software project based on the project's defined software process. [Integrated Software Management Ability 3]
- Software testing is performed according to the project's defined software process. [Software Product Engineering Activity 5]

Additional Key Practices associated with CMM Level 3 and beyond include practices to ensure time and resources are allotted to execute software development activities as well as tasks related to the software process (Paulk, Weber, et al., 1993):

- Adequate resources and funding are provided for performing the software engineering tasks. [Software Product Engineering Ability 1]
- Adequate resources and funding are provided for the organization's software process activities. [Organization Process Focus Ability 2]

Given the empirical findings of reduced overtime as organizations move from CMM Level 1 to Level 3 and Key Practices associated with Level 3 that reflect improved resource management, we extend the following hypothesis regarding work overload:

> *Hypothesis 3: Perceived work overload reported by IS professionals in CMM Level 1 organizations is significantly higher than that reported by IS professionals in organizations at CMM Level 3 and above.*

A theme emerging from the anecdotal literature on CMM initiatives is one of skepticism, or doubt, on the part of developers. Rainer, Hall, and Baddoo (2003) acknowledged the need to persuade developers to buy into process improvement efforts. In a content analysis of four articles on software process improvement and transcription data from interviews conducted at one company, they concluded that most developers are skeptical about process improvement and need to see evidence of the benefits of process change. The cynicism of developers is reflected in Rainer et al.'s (2003) conclusion that even if researchers could demonstrate a strong, reliable relationship between software process improvement and improved organizational performance, there would still be the problem of convincing developers that the evidence applies to their particular situation.

Goldenson and Herbsleb (1995) identified cynicism stemming from prior experience as an obstacle that can thwart process improvement efforts. Similarly, Moitra (1998) determined that doubt about the effectiveness of new processes was a major difficulty associated with improvement initiatives, and further observed that software engineers often perceived the process change to only be for the benefit of management. Along this line, Stelzer and Mellis (1998, p. 239) maintained that "mere conformance to a standard, attaining certification, or reaching a CMM level usually is not a relevant goal for staff members."

Cynicism reflects doubt and distrust. In the workplace literature, the concept of cynicism has been operationalized as a mental distancing from one's work (Schaufeli, Leiter, and Kalimo, 1995). Given its persistence in anecdotal reports regarding CMM initiatives, we examine the construct in our study and posit cynicism to be higher among IS professionals in earlier levels of the CMM. As organizations reach CMM Level 3 and beyond, benefits of process changes should become apparent, and IS workers are likely to have experienced some of those first hand (e.g., less overtime). This should alleviate doubts and distrust that may have been present at the outset of the CMM journey, thereby reducing cynicism.

As a result, we extend the following hypothesis regarding cynicism:

> *Hypothesis 4: Cynicism reported by IS professionals in CMM Level 1 organizations is significantly higher than that reported by IS professionals in organizations at CMM Level 3 and above.*

In their case study of an organization at CMM Level 2, Hyde and Wilson (2004) included the item "Increased levels of confidence" in their survey of software professionals, and found mostly agreement. The construct of professional

efficacy captures an individual's perceived effectiveness and accomplishment at work (Schaufeli, et al., 1995), and we utilize this construct to further investigate the initial finding by Hyde and Wilson (2004). CMM Level 1 is characterized as ad hoc and at times chaotic, with success frequently dependent on heroic efforts. This type of unstructured, undependable environment can lead to rework and struggles to correct and recover. As organizations climb the CMM ladder, processes become defined and standardized; this should provide a smoother, more direct path to effective completion of tasks and projects and, hence, higher perceptions of professional efficacy.

Furthermore, the measurement inherent in higher levels of CMM maturity is likely to contribute to perceptions of effectiveness and accomplishment in one's work. For example, the Level 3 practice of "Measurements are made and used to determine the functionality and quality of the software products" [Software Product Engineering Measurement 1] reflects the assessment and reporting of defects and test case results (Paulk, Weber, et al., 1993). Perceptions of effectiveness and accomplishment are likely to rise as reported defects decline and test cases are documented and successfully completed.

We therefore extend the following hypothesis concerning professional efficacy:

> *Hypothesis 5: Professional self-efficacy reported by IS professionals in CMM Level 1 organizations is significantly lower than that reported by IS professionals in organizations at CMM Level 3 and above.*

In summarizing benefits of CMM improvement efforts, Capell (2004) included improved employee morale. While most publications that cite this benefit have not empirically assessed employee morale (e.g., Brodman and Johnson, 1995; Dangle, Larsen, and Shaw, 2005), two have: the previously discussed studies by Herbsleb et al. (1997) and Hyde and Wilson (2004). A generally neutral response regarding improved morale was observed by Hyde and Wilson in an organization at CMM Level 2, while Herbsleb and his colleagues reported a large increase in morale between Level 1 and Level 3. Although results between these two studies were somewhat mixed, we follow the anecdotal literature and Herbsleb et al., 1997, to expect higher morale among IS professionals in organizations at higher levels of the CMM. We assess employee morale as the affective commitment reported by IS professionals. Affective commitment reflects an employee's desire to remain a part of the organization, including the individual's belief in the goals and values of the organization and willingness to put forth effort on behalf of the organization (Mowday, Porter, and Steers, 1982).

We extend the following hypothesis regarding affective commitment:

> *Hypothesis 6: Affective commitment reported by IS professionals in CMM Level 1 organizations is significantly lower than that reported by IS professionals in organizations at CMM Level 3 and above.*

Higher job satisfaction is often linked to progression up the CMM ladder, though only Yamamura and Wigle (1997) have provided empirical evidence of the linkage. Aforementioned methodological concerns temper interpretation of their findings, but the study does provide initial empirical support for higher job satisfaction in organizations at higher levels of the CMM. Utilizing a multi-dimensional conceptualization of job satisfaction that encompasses satisfaction with pay, job security, supervisor, growth, and social aspects including coworkers, we expect job satisfaction to be higher for IS professionals in organizations at CMM Level 3 and above than for IS professionals at Level 1. Accordingly, we extend the following hypothesis regarding job satisfaction:

> *Hypothesis 7: Job satisfaction reported by IS professionals in CMM Level 1 organizations is significantly lower than that reported by IS professionals in organizations at CMM Level 3 and above.*

Method

In this section, we describe the process used to select companies and participants for our sample. We also explain our method of data collection and the measures used.

Company Selection

Over 40 IS companies were contacted and requested to participate in the survey. The following sources were used to identify companies for participation: industry contacts, SEI Lead Assessors, companies that provide software

process improvement services, Software Process Improvement Networks (SPIN chapters) and Project Management Institute (PMI) chapters. To ensure as much organizational stability as possible, specific criteria had to be met in order to participate in the survey. The company had to be in business for at least two years and have a minimum of 50 IS professionals. Companies could not have had a layoff within the past six month or have one planned in the near future. Organizations that were CMM Level 3 or greater had to already be at this level for six months or longer.

Ten companies of various levels of CMM maturity agreed to participate. Two of these companies had IS organizations at multiple levels of the CMM: one company had CMM Levels 3 and 4; one company had CMM Levels 1, 3, and 5. The remaining eight companies functioned at only one level of the CMM. In total, six companies participated in the CMM Level 1 group, five companies in the Level 3 group, one company at Level 4 and one company at Level 5.[1]

A company sponsor with the authority to distribute the survey was identified for each participating company. Surveys for the organizations functioning at each CMM level within one company were administered separately. A total of 736 IS workers participated in the study. The breakdown of organizations and participants by CMM level is provided in Table 2.

Table 2. Organizations and Participants in Sample

CMM Level	Org A	Org B	Org C	Org D	Org E	Org F	Org G	Org H	Org I	Org J	Number of Participants
1	√			√		√	√		√	√	417
3		√	√		√			√	√		214
4								√			91
5									√		14
											Total = 736

Participants

Participants were identified as IS professionals who supported various types of software development, systems integration, or software maintenance projects. Typical roles included program/project managers, systems architects, technical leaders, business analysts, requirements managers, developers, documentation/graphics specialist, configuration management specialists, testers, quality assurance and human-computer interface specialists. Executive or functional roles such as legal, finance, human resources, sales, and marketing were excluded.

Data Collection

An internet-hosted survey (www.inquisite.com) was used to collect survey responses. Surveys were administered and tracked separately for each company and for each different CMM level within a company. A sponsor within each company was sent a unique URL and a sample email to send to his/her IS group. The email was then distributed within each organization, requesting voluntary participation from employees who worked on IS projects. Confidentiality and anonymity were assured for each participant.

Response bias was minimized by stating that the survey was being conducted in the context of measuring job attitudes and intentions, with no mention of CMM initiatives in the survey or sample email. The variables being measured were grouped together but were not explicitly defined. Thus, a participant did not know that questions were related to role ambiguity, role conflict or the other variables.

[1] It is not uncommon for large companies to have separate internal organizations or divisions at different CMM levels. For example, a company that offers IS services to the government and private clients will likely establish different divisions and cost centers. Government contracts for large software development programs usually require an organization to be compliant at CMM Level 3 whereas there may be no CMM requirement for private clients.

Surveys were active for approximately eight business days with a reminder email sent by the company contact after the third or fourth day after survey activation. The survey was deactivated after a given time and no additional responses were allowed. Survey response data was then downloaded and summarized for each company and its associated CMM Level and aggregated into the appropriate maturity level in the sample. The response rate was high, averaging approximately 50 to 65 percent for participating companies.

Measures

We used measures validated in prior research to evaluate the influence of CMM on positive (professional efficacy, affective commitment, job satisfaction) and negative (role conflict, role ambiguity, work overload, cynicism) workplace outcomes. The source and number of scale items for each measure are provided in Table 3. We also collected age, organizational tenure, and company from participants to enter as control variables in our analysis.

Table 3. Measures

Measure	*Source*	*Number of items*
Affective Commitment	Meyer & Allen, 1997	7
Cynicism	From MBI-GS, Consulting Psychologists Press	5
Job Satisfaction[2]	From JDS (Hackman & Oldham, 1974, 1975, 1980)	14
Professional Efficacy[3]	From MBI-GS, Consulting Psychologists Press	6
Role Ambiguity	Rizzo, House, & Lirtzman, 1970	6
Role Conflict	Rizzo, House, & Lirtzman, 1970	8
Work Overload	Kirmeyer & Dougherty, 1988	4

Results

We patterned our analysis after prior research examining work attitudes and group differences in organizations (Lim and Cortina, 2005). First, we evaluated the factor structure of our variables and then we conducted a MANCOVA. Table 4 reports descriptive statistics, the correlation of constructs, composite reliabilities, and average variance extracted.

Confirmatory Factor Analysis

We used LISREL 8.8 to conduct confirmatory factor analyses to validate the factor structure of our latent variables (Joreskog and Sorbom, 2006). This analytic technique allows one to generate an estimated covariance matrix by solving a series of regression equations simultaneously. The estimated matrix is then evaluated against the actual sample covariance matrix to determine whether the hypothesized model is an acceptable representation of the data. To assess data-model fit, a variety of statistics was examined, including the normed fit index (NFI), the nonnormed fit index (NNFI), the comparative fit index (CFI), the root mean squared error of approximation (RMSEA), and the standardized root mean squared residual (SRMSR). Because of the high correlation between job satisfaction and affective commitment in our initial data analysis, we chose to decompose satisfaction into its five facets – pay, growth, security, supervision, and social. By doing so, we were able to discriminate between commitment and different facets of satisfaction and to achieve an understanding of the influence of CMM level on employees' satisfaction with various aspects of their jobs. The revised measurement model results support our proposed factor structure fit with the data: NFI .95, NNFI .96, CFI .96, RMSEA .06, SRMSR .07.

[2] The 14-item Job Satisfaction scale consisted of these subscales with number of items indicated in parentheses: Growth (4), Pay (2), Security (2), Social (3), Supervision (3).

[3] In the MBI-GS instrument, all items in the professional efficacy scale are reverse scored. We did not reverse score these items, so that a high value on the professional efficacy scale in our data represents a high level of professional efficacy.

Table 4. Means, Standard Deviations, Correlations, and Average Variance Extracted

				Correlation of Constructs and Square Root of the AVE[b]									
Variable	**Mean**	**Std. Dv.**	**ICR[a]**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**
1. Role Conflict	3.74	1.49	**0.89**	**0.72**										
2. Role Ambiguity	3.63	1.25	**0.88**	0.55	**0.75**									
3. Work Overload	4.67	1.63	**0.80**	0.56	0.26	**0.72**								
4. Cynicism	3.16	1.39	**0.82**	0.44	0.50	0.21	**0.72**							
5. Professional Efficacy	2.80	1.08	**0.75**	-0.08	-0.39	-0.05	-0.31	**0.71**						
6. Affective Commitment	3.35	1.24	**0.89**	-0.33	-0.47	-0.10	-0.57	0.23	**0.74**					
7. JS – Pay	4.27	1.34	**0.90**	-0.31	-0.27	-0.25	-0.15	0.06	0.32	**0.90**				
8. JS – Growth	4.76	1.19	**0.81**	-0.35	-0.61	-0.12	-0.70	0.32	0.73	0.36	**0.72**			
9. JS – Security	4.02	1.48	**0.90**	-0.24	-0.33	-0.20	-0.35	0.10	0.44	0.36	0.52	**0.91**		
10. JS – Supervision	4.58	1.30	**0.87**	-0.39	-0.56	-0.18	-0.49	0.23	0.51	0.30	0.64	0.34	**0.84**	
11. JS – Social	4.79	1.06	**0.67**	-0.23	-0.37	-0.11	-0.42	0.20	0.55	0.21	0.60	0.31	0.48	**0.71**

[a]Internal composite reliability (ICR) is calculated by squaring the sum of loadings then dividing it by the sum of squared loadings plus the sum of the error terms. Interpreted like a Cronbach's alpha, an ICR of 0.60 is sufficient for research.

[b]The average variance extracted (AVE) measures the variance captured by the indictors relative to measurement error. To use a construct, AVE should be greater than 0.50. To demonstrate adequate discriminant validity, the square root of the AVE should be greater than the off-diagonal elements of the correlation of constructs.

MANCOVA

To examine the influence of CMM levels, we conducted a MANCOVA with CMM level as a predictor and age, tenure, and company (entered as a series of dichotomous variables) as covariates in SPSS 15.0 (2006). An extension of analysis of variance, the MANCOVA procedure allows us to examine whether both type and frequency of job attitudes and perceptions are significantly associated with mean differences across CMM levels in linear combinations of outcomes. By estimating a series of related outcomes simultaneously, this analysis maximizes parsimony while reducing alpha inflation.

We performed separate multivariate analyses of covariance on the two sets of dependent variables, namely, negative workplace outcomes (role conflict, role ambiguity, work overload, cynicism) and positive workplace outcomes (professional efficacy, affective commitment, job satisfaction). We collected smaller samples from organizations at CMM Levels 4 and 5; a single organization was represented in Level 4 and a (different) single organization was represented in Level 5. Consequently, responses from Level 4 and Level 5 organizations were combined, providing three groups for the MANCOVA test: responses from participants in organizations at CMM Level 1, participants in organizations at Level 3, and participants in organizations at Level 4/5. Results suggested CMM level to be significantly related to negative workplace outcomes, Wilks's lambda .93, $F(10, 1457) = 5.59$ $p<.01$, and to positive workplace outcomes, Wilk's .89, $F(14, 1450) = 7.35$, $p<.00$.

ANCOVA

To understand which job attitudes and perceptions differ by CMM level, follow-up ANCOVAs were conducted on the individual positive and negative outcomes. The test is based on the linearly independent pairwise comparisons among the estimated marginal means. See Table 5 and Table 6 for a summary of results.

For negative workplace outcomes, inspection of mean differences and parameter estimates suggests that role conflict, role ambiguity, and work overload decline from CMM Level 1 to CMM Level 3 to CMM Level 4/5. Role conflict at Level 3 was significantly lower than that reported at Level 1, and role conflict at Level 4/5 was significantly lower yet than at Level 3; hence, *H1 is supported*. Role ambiguity at Level 4/5 was significantly lower than that reported at both Level 1 and Level 3, and the Level 3 group mean for role ambiguity was lower than the mean for Level 1 but not significantly so. *H2 was partially supported*, as role ambiguity was not significantly lower at Level 3 than at Level 1, though our data does reflect a trend toward lower role ambiguity at higher levels of the CMM (Level 4/5). Work overload at both Level 3 and Level 4/5 was significantly lower than that reported at Level 1, *supporting H3*.

In contrast to the trend of negative elements declining at higher CMM levels, cynicism showed a pattern of increase. Cynicism at Level 4/5 (mean = 3.72) was significantly higher than cynicism reported at Level 1 (mean = 3.44). The Level 3 group mean for cynicism (mean = 3.69) was also higher than the mean for Level 1, but not significantly so. *H4 is not supported*, as our findings for cynicism are in the opposite direction of what was posited.

Table 5. Univariate Tests

Negative Workplace Outcomes

Dependent Variable	Sum of Squares	Error	df	Df error	Mean Square	Mean Square Error	F	Sig.
Role Conflict	21.80	848.46	2	726	10.90	1.11	9.79	0.00
Role Ambiguity	11.30	675.58	2		5.65	.931	6.07	0.00
Work Overload	28.70	908.38	2		14.35	1.25	11.47	0.00
Cynicism	7.38	912.56	2		3.69	1.26	2.94	0.00

Positive Workplace Outcomes

Dependent Variable	Sum of Squares		df		Mean Square	Mean Square Error	F	Sig.
Professional Efficacy	3.45	416.40	2	726	1.72	.57	3.00	0.00
Affective Commitment	4.35	746.70	2		2.18	1.03	2.11	0.00
JS-Pay	21.44	1127.28	2		10.72	1.55	6.90	0.01
JS-Growth	1.52	675.61	2		.762	.931	0.82	0.44
JS-Security	75.66	1206.19	2		37.83	1.66	22.77	0.00
JS-Supervision	0.30	970.48	2		0.15	1.34	0.12	0.89
JS-Social	1.25	481.63	2		.628	.663	.95	0.39

Table 6. Mean Differences[a]

Negative Outcomes				Positive Outcomes			
	CMM	Mean	Std. Error		CMM	Mean	Std. Error
Role Conflict	1	4.22	0.06	Professional Efficacy	1	4.36	.04
	3	3.93[b]	0.09		3	4.15[b]	.07
	4/5	3.67[b]	0.11		4/5	4.21	.08
Role Ambiguity	1	3.58	0.05	Affective Commitment	1	4.12	.06
	3	3.48	0.08		3	3.88[b]	.09
	4/5	3.17[bc]	0.11		4/5	4.11	.11
Work Overload	1	4.55	0.06	JS-Pay	1	4.17	.07
	3	4.38[b]	0.10		3	4.17	.11
	4/5	3.98[b]	0.11		4/5	4.70[bc]	.13
Cynicism	1	3.44	0.06	JS-Security	1	3.86	.08
	3	3.69	0.10		3	4.28[b]	.12
	4/5	3.72[b]	0.11		4/5	4.89[bc]	.13

[a] Covariates included in the model were company, age, tenure

[b] Significantly different from CMM1

[c] Significantly different from CMM3

For positive workplace outcomes, inspection of mean differences and parameter estimates suggests that professional efficacy and affective commitment may take a dive for IS workers at CMM Level 3. Rather than advancement in CMM contributing to enhanced professional efficacy as posited in H5, the mean professional efficacy for Level 3 respondents was significantly lower than the mean for IS workers in Level 1 organizations. Similarly, affective commitment reported by respondents in organizations at CMM Level 3 was significantly lower than the mean for respondents at Level 1. These findings for professional efficacy and affective commitment were the opposite of what was expected, indicating a *lack of support for H5 and H6*.

Finally, due to inadequate discriminant validity between affective commitment and general job satisfaction in our data, we assessed H7 by examining the individual facets of satisfaction. Our respondents reported significantly higher levels of pay satisfaction in organizations at CMM Level 4/5 than at Levels 1 and 3. Satisfaction with job security rose as organizations climbed the CMM ladder; job security satisfaction at Level 3 was significantly higher than at Level 1, and the mean at Level 4/5 was significantly higher yet than at Level 3. The CMM groups did not significantly differ on the other dimensions of job satisfaction (growth, supervision, social). Given that the means for some facets of job satisfaction were significantly higher for respondents in organizations at higher levels of the CMM, *H7 was partially supported*.

Discussion

Our findings were not fully in line with the anecdotal literature or with the few preliminary empirical studies. While our data tended to support expectations that role conflict, role ambiguity, and work overload were lower for IS professionals in organizations at higher CMM levels, reports of cynicism were higher in upper levels of the CMM. And, while we expected to observe higher professional efficacy and affective commitment at higher CMM levels, we found that IS workers reported significantly lower professional efficacy and commitment at Level 3 than at Level 1. These results indicate that the experience of IS professionals in CMM initiatives is more complex than the literature to-date implies.

Further examination of our data suggests that affective commitment and professional efficacy may rebound from their dip at Level 3, once organizations achieve Level 4/5. This does not appear to happen with cynicism, however, which was highest in Level 4/5 of our sample. Cynicism reflects a disengagement, or mental distancing, from one's work, and conceptually stems from doubt and distrust.

Given the "common wisdom" that has repeatedly linked CMM progression to improved employee satisfaction, the lack of significant differences in satisfaction with supervisor, satisfaction with growth, and social satisfaction (which includes satisfaction with coworkers) across CMM levels is remarkable. The significant differences found in pay satisfaction and job security satisfaction may be connected to traditional organization-level benefits associated with CMM initiatives. That is, as organizations reach higher levels of the CMM, the stability and profits of the firm may improve, leading to increased job security and pay for employees.

This new perspective on job attitudes and perceptions of IS professionals in organizations at varying levels of the CMM provides a springboard for further research, as well as implications for practitioners.

Directions for Future Research

This research was focused on organizational maturity of IS organizations as defined by the Software Engineering Institute's Software Capability Maturity Model process improvement framework. Future studies with companies using other improvement frameworks (e.g., Six Sigma initiatives, lean manufacturing, Total Quality Management, Malcolm Baldrige) would provide insights into the impacts that improvement initiatives overall have on a company's workforce in terms of employee attitudes and perceptions.

Additional studies should group IS workers by function and job role to determine if changes wrought by improvement initiatives exert different impacts on disparate parts and members of the IS organization. And examining variables such as autonomy, perceived organizational support, job availability, and turnover intent could yield further insight into the influence of improvement initiatives on IS workers' attitudes and relationship with their employing organization.

The research presented in this paper was based on surveys collected from companies at CMM Level 1, 3, 4, and 5, with the intention of focusing on low and high maturity organizations. Future research should include all levels of the CMM (or the current CMMI) to provide results across all levels. In doing so, because high attrition rates characterize longitudinal survey-based studies, a case study approach within a single organization as it progresses through levels of the framework may be a fruitful approach for gleaning additional insights into the experience of IS professionals during the organization's "CMM journey." In particular, researchers should consider qualitative work that focuses on understanding whether change required by CMM levels relate to professionals' attitudes prior to, during, and after implementation within diverse types of organizations.

An understanding of why a company has chosen to embark upon a CMM process improvement initiative would provide further insights into contextual influences on employee job attitudes and perceptions. For example, if the CMM is being used to meet requirements for doing business with the government, "getting the boxes checked" may seem more important than actually making improvements. If sponsors of CMM initiatives have unrealistic expectations in terms of organizational change, the amount of work required, or how quickly change can be affected, employees may have additional work to perform to support the improvement activities in addition to his/her project work.

Understanding the broader context (i.e., organizational stress) surrounding a CMM-based initiative would provide additional insights into its influence on employees. For example, if a firm implements an enterprise-wide initiative and CMM-based improvement concurrently, one might find employees express higher levels of stress than in a firm that implemented a single organizational change initiative. Each change initiative can be expected to have substantive effects and simultaneous initiatives may interact with each other in interesting ways.

Finally, people who were very busy may not have participated in this survey due to time constraints. If that is the case, role stressors and work overload may actually be higher than reported in our study. Using a data collection method that could ensure an accurate cross-section of IS professionals is encouraged. And, as this research was limited to US-based companies, future research in other countries would be helpful to better understand cultural differences for IS professionals.

Implications for Practice

This research has important implications for managers of IS professionals. First, organizations deciding to use the CMM framework starting at Level 1 performance face substantial change in routines and adoption of new processes within their IS organizations over a period of several years. Change management research suggests that workers report feelings of stress when confronted with, and report substantial cynicism about, organizational change initiatives (Armenakis and Bedian, 1999). To mitigate effects of cynicism and stress, this literature suggests managers build strong relationships with their employees, clearly communicate the timing and nature of changes, and emphasize the positive outcomes of change for all workers in the organization (Armenakis and Bedian, 1999; Reichers, Wanous, and Austin, 1997). Given the critical role of leadership, organizations should consider offering managers training on CMM and change management prior to embarking on the CMM journey.

When communicating with employees, our research suggests that the organization should emphasize the positive outcomes that are directly pertinent to IS professionals, namely, the reduction in perceived workload, role conflict, and role ambiguity that tend to be reported by IS staff in organizations at CMM Levels 3, 4, and 5. Through underscoring that carefully managed changes can lead to positive outcomes for IS professionals, managers may increase buy-in to the organizational transformations required to move from CMM Level 1 to CMM Level 3 and beyond. To win buy-in, managers need to carefully describe the potential and pitfalls of CMM implementation to existing employees. To do so, managers can use tools such as project charters and RACI (responsibility, accountability, consult, inform) charts that effectively convey responsibilities to IT professionals. Through effective communication and project management, organizations will create realistic expectations and foster more positive perceptions of changes wrought by growing compliance with CMM guidelines.

Second, to realize the full potential of CMM guidance, including the positive impacts it can have on the work environment of IS professionals, managers should focus efforts on reaching CMM Levels 4 and 5. Our findings suggest that the move from CMM Level 1 to Level 3 is the toughest time for IS workers, as they report higher cynicism, lower professional efficacy, and lower commitment to their employer. At Levels 4 and 5, our findings suggest that IS professionals bounce back to a certain extent, as professional efficacy and commitment return to levels comparable to those reported at the initial rung of the CMM ladder. These findings imply that organizations that make it to CMM Levels 4 and 5 are more likely to reap the rewards of fostering more satisfied, committed

employees which may lead to correspondingly higher levels of performance and lower levels of turnover. By setting their sights on the higher CMM levels, firms are more likely to secure a stable pool of IS professionals necessary for realizing CMM goals such as defect reduction and productivity improvement.

Third, given that the CMM requires individuals to adhere to more disciplined software development processes, hiring managers should carefully screen employees based on their "fit" with the maturity level of their organization. As noted by Adler et al (2005, p. 244), organizations that aspire to higher levels of CMM may not be a good fit for "free spirits who don't believe in process." Given that higher feelings of stress and lower feelings of satisfaction may drive higher turnover (Griffith, Hom, and Gaertner, 2000), managers should ensure future hires understand that they will be entering a structured software development environment. Through providing potential employees a realistic job preview (Breaugh and Billings, 1988), managers afford job candidates opportunities to assess their fit within the organization. If a hired candidate "fits" with the organization, the employee is likely to report higher job satisfaction and perform at higher levels (Kristof-Brown, Zimmerman, and Johnson, 2005).

Conclusion

Grover, Lyytinen, Srinivasan, and Tan (2008) recently called for IS researchers to look for new and conflicting patterns in data and to utilize multi-level data because it can offer richer perspectives. Grover and his colleagues (2008, p. 46) urge us to "seek contradictions… or what surprises practitioners." Our findings offer surprises and contradictions and, in doing so, position the IS community for further discovery and theory development regarding the impact of the CMM journey on IS professionals. Such research efforts should lead to a more thorough understanding of the "contradictions" in our results, as well as discovery of nuances associated with findings that were in line with prior anecdotal reports. For practice, our results offer insight into specific positive and negative responses of IS professionals in the CMM climb. This knowledge enables managers to anticipate rough patches for IS professionals and be proactive in smoothing the IS worker's journey through these complex periods.

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