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An Application of the Deming Management Method for Information Technology Projects

Jack T. Marchewka
Northern Illinois University

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ABSTRACT

Although the ideas and teachings of W. Edwards Deming have been implemented in organizations world-wide for over the past 50 years, only three studies have empirically tested a theoretical model grounded in the Deming Management Method. These studies focused on the manufacturing and services area. Today, quality management continues to be an area of interest both in project management and software engineering. The focus of this study is to test the Deming Management Method in information technology (IT) projects. A survey of 63 IT professionals provides empirical support for the Deming Management Method and its application to IT projects. A correlation analysis of the hypothesized relationships were all found to be positively and significantly related. Subsequently, it appears that there is strong support for applying the teachings and ideas of W. Edwards Deming to IT project quality management. While the correlation analysis provides support for the Deming Management Method, a descriptive statistical analysis provides some insight into how many of Deming's ideas and teachings are being applied explicitly or implicitly in the development of information systems.

INTRODUCTION

Although the concepts and philosophies of quality management were popularized by the Japanese, many organizations throughout the world have initiated quality management programs. Such programs include ISO certification, Six Steps to Six Sigma initiatives, or awards such as the Deming Prize or the Malcolm Baldrige National Quality Award (MBNQA). Based on the writings and teachings of such quality gurus as Shewhart, Deming, Juran, Ishikawa, and Crosby, the core values of these quality programs have a central theme that includes a focus on the customer, leadership, incremental or continuous improvement, and the idea that prevention is less expensive than correction.

Quality management has received a great deal of attention over the last fifty years in the manufacturing and services sectors; however, many of these same ideas are just beginning to be applied to information technology (IT) projects (Marchewka, 2006). For example, the Capability Maturity Model (CMM) provides a framework for software quality that focuses on assessing the process maturity of software development within an organization. In addition, a relatively new knowledge area called project quality management (PQM) focuses on project products and processes so that organizations may invest resources more efficiently and effectively, minimize errors, and meet or exceed client/project sponsor expectations. Project quality management is becoming increasingly important because failure to meet project quality requirements and standards can have negative consequences for all project stakeholders. IT project objectives can be adversely affected if additional work and repeating project activities extend the IT project schedule or budget (Marchewka & Keil, 1995). According to Barry Boehm (1981), a software defect that takes one hour to fix when the systems requirements are defined will end up taking one hundred hours to correct if not discovered until the system is in production. However, studies published in the information systems (IS) literature have tended to focus primarily on measuring the quality of service the information systems department provides to the organization (Kettinger & Lee, 1997,1999; Van Dyke, Kappelman & Prybutok, 1997; Whitten, 2004), but no studies have focused on quality management at the project level – i.e., the actual development of the information system.

W. Edwards Deming was one of the strongest proponents of quality management, and in his book, *Out of the Crisis*, Deming outlined a set of 14 points that provide a foundation for quality management. Although Deming's philosophies have been embraced around the world, only three studies have empirically tested a theoretical model

grounded in the Deming Management Method. Two of these studies focused on manufacturing organizations (see Anderson, Rungtusanatham, Schroeder, & Devaraj (1995); Rungtusanatham, Forza, Filippini, & Anderson, 1998), and the other on service organizations (see Douglas & Fredendall, 2004).

Given that many of Deming's philosophies, teachings, and fundamental principles are being applied to IT project management in practice, the objectives of this proposed research includes:

- Evaluating the constructs and relationships of the model to assess their relevance to information technology projects
- Testing a conceptually-based, empirically-tested model to evaluate the generalization of the Deming management method to information technology projects.
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The findings of this study should be of interest to both academics and the business community. For academics, this study will provide an empirical examination of a theoretical model that has received little attention in the quality management and information systems literature but has received a great deal of interest, attention, and application in practice. For managers, this study should be useful in identifying and understanding various constructs and relationships to support a major quality initiative.

THE DEMING MANAGEMENT METHOD

The Deming Management Method (DMM) in Figure 1 was developed by Anderson, Rungtusanatham, & Schroeder (1994) based on the work of W. Edwards Deming as well as other quality management experts. Subsequently, there have been only three empirical studies of the Deming Management Method in the literature. First, Anderson, Rungtusanatham, Schroeder, and Devaraj (1995) found general support for the model, while Rungtusanatham, Forza, Filippini, and Anderson (1995) replicated the study using manufacturing plants located in Italy and found general support for the model as well. More recently, Douglas and Fredendall (2004) tested the model using U.S. hospitals as the unit of analysis and found general support for the model.

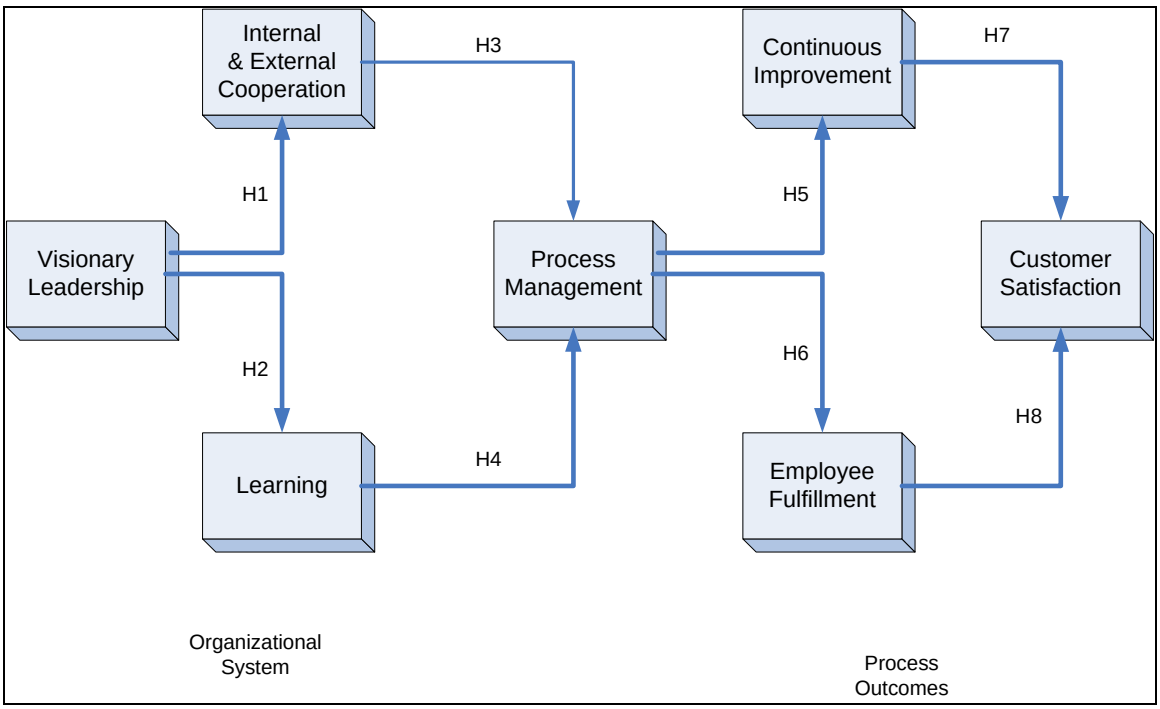

Figure 1: Deming Management Method.

The constructs of the Deming Management Method are summarized in Table 1 along with their context in the manufacturing and services are as well as how they may be generalized to an IT project management context.

Table 1: Summary of Deming Management Method Constructs and Generalizability to IT Project Management.

Construct	Manufacturing & Service Context	IT Project Context
Visionary Leadership	Management's ability to establish, practice, and lead a long-term vision for the organization, as well as respond to changing customer requirements.	Management's ability to establish a clear vision and effective project environment that enables the project team to meet or exceed internal or external customer expectations.
Internal & External Cooperation	The organization's propensity to engage in noncompetitive activities internally with its employees and externally with suppliers.	The project team's ability to engage in cooperative activities internally with each other while acting in concert with external project stakeholders.
Learning	The organization's ability to recognize and nurture employee skills, abilities, and knowledge base.	The project team's skills, experience, and ability to build upon an existing knowledge base while developing lessons learned that can be developed into a set of shared best practices.
Process Management	A set of methodologies and behavioral practices that emphasize the management of processes, or means of action, rather than results.	The project management and software development processes that are documented, integrated, and repeatable by project team members and by the project organization.
Continuous Improvement	The organization's propensity to pursue incremental and innovative improvements of its processes, products, and services.	The project team's propensity to pursue incremental and innovative improvements of its project management and software processes and deliverables.
Employee Fulfillment	The degree to which employees of an organization feel that the organization continually satisfies their need.	The degree to which project team members feel that their contribution to the project is meaningful and satisfies their needs.
Customer Satisfaction	The degree to which an organization's customers believe that their needs are being met by the organization's products or services.	The degree to which a project's internal or external customers perceive that the completion of the project will meet or exceed their expectations or needs.

Hypotheses

The Deming Management Method allows for the testing of several hypotheses. These hypotheses and their rationale are summarized in Table 2.

Table 2: Summary of Hypotheses.

Hypothesis	Rational
H1: Visionary leadership is positively related to internal and external cooperation	A leader with vision is one of the core tenants of the Deming Management Method. It is essential that the top management play a leadership role so that the project team cooperates internally with one another and with other external stakeholders.
H2: Visionary leadership is positively related to learning	Top management can control learning by allocating resources for such things as training or by choosing whether to encourage and reward experiential learning and the sharing of experiences in terms of lessons learned or best practices.

H3: Internal and external cooperation is positively related to process management.	Cooperation among project team members and external stakeholders should lead to new ideas for better managing the project and/or building information systems.
H4: Learning is positively related to process management	Learning should lead to improved process management in terms of lessons learned and the identification of new best practices or the refinement of existing processes. This is similar to the Capability Maturity Model's concept of process maturity and capability.
H5: Process management is positively related to continuous improvement	There is increasing pressure to deliver IT projects that provide value to the organization on time and within budget. Subsequently, process management should encourage or include means for continuous improvement as the project team constantly looks for ways to refine and standardize project and software development processes.
H6: Process management is positively related to project team member fulfillment	Since project team members must use project and software development processes, it follows that superior process management methods should help increase a project team member's satisfaction.
H7: Continuous improvement is positively related to project performance and customer satisfaction	The original model proposes that customer satisfaction is the result of both continuous improvement and employee satisfaction. In this context, continuous improvement should enable the project team to deliver an information system solution that meets or exceed the client or sponsor's expectations.
H8: Project team member fulfillment is positively related to project performance and customer satisfaction.	Project team members who have a sense of fulfillment should be motivated to perform at higher levels. In turn, this should result in the delivery of an IT solution that meets or exceeds a client or sponsor's expectations.

RESEARCH METHODOLOGY

An online survey was developed based on the questionnaire used by Douglas and Fredendall (2004). The five-point Likert scales were adapted to an IT project environment. Individuals from various organizations were contacted and asked if other individuals in their organization would be interested in participating in this study. If permission was given, a link to the survey's web site was emailed to that individual along with a document that explained the intention of the study and the criteria for those who would be target participants. In short, target participants included IT professionals who currently were involved in an IT project. This would include, for example, project managers or leaders, system analysts, programmers, consultants, and so forth as opposed to individuals who work help desk support or PC maintenance.

A total of 64 participants responded over a two-month period and resulted in 63 usable responses. Fifty-three (84%) of the respondents were male with 10 (16%) female. Tables 3, 4, 5 and 6 provide summaries of the respondents' reported ages, education, work experience, and years in their current position.

Table 3: Current Ages (in years).

Years	Frequency	Percent
20 - 29	8	12.7%
30 - 39	24	38.1%
40 - 49	17	27.0%
50 - 59	8	12.7%
Over 60	6	9.5%
Total	63	100.0%

Table 4: Education Completed.

Earned Degree	Frequency	Percent
2 Year College Degree	3	4.8%
4 Year College Degree	26	41.3%
Masters Degree	34	54.0%
Total	63	100.0%

Table 5: Years Work Experience.

Years	Frequency	Percent
2 to 5	6	9.5%
6 to 10	12	19.0%
11 to 15	10	15.9%
16 to 20	10	15.9%
More than 20	25	39.7%
Total	63	100.0%

Table 6: Years in Current Position.

Years	Frequency	Percent
Less than 1	17	27.0%
1 to 3	15	23.8%
4 to 6	16	25.4%
7 to 10	8	12.7%
More than 10	7	11.1%
Total	63	100.0%

In addition, a reliability analysis was conducted for the scales using a Cronbach's Alpha. As summarized in Table 7, each of the scales that represent the Deming Management Method's constructs appears to have a good degree of reliability since each computed statistic is above .70.

Table 7: Summary of Reliability Analysis for n = 63.

DMM Construct	Measure/Scale	Cronbach's Alpha	Number of Items
Visionary Leadership	Top Management Team Involvement	.886	5
Internal/External Cooperation	Quality Philosophy	.823	5
	Supplier/Subcontractor Involvement	.797	6
Learning	Total Quality Training	.889	6

	Customer Driven Information	.714	4
Process Management	Process Management – Project	.871	5
	Process Management – Software Engineering	.883	5
	Management By Fact	.920	6
	Total Quality Methods	.790	5
Continuous Improvement	Continuous Improvement	.814	4
Employee Fulfillment	Employee Fulfillment	.793	5
Project Performance	Perceived Project Performance	.919	3
	Perceived Customer Satisfaction	.929	3
Business Performance	Perceived Business Performance	.952	5

RESULTS AND ANALYSIS

In this section, the hypothesized relationships in Figure 1 are tested and analyzed. A positive relationship is hypothesized for each of the constructs in the Deming Management Method. Therefore, a correlation analysis was conducted to test the relationship among the model's constructs. In addition, descriptive statistics for each of the items making up the scales or constructs are presented as well to provide additional insight. In short, all of the hypothesized relationships were found to be positively and significantly correlated.

H1: Visionary Leadership is Positively Related to Internal and External Cooperation.

The first hypothesis focuses on the relationship between Visionary Leadership and Internal/External Cooperation. Douglas and Fredendall (2004) used Top Management Team Involvement to represent Visionary Leadership, while Quality Philosophy and Supplier Involvement were used to represent Internal and External Cooperation. However, in this study, the construct of Supplier Involvement was expanded to include subcontractor or outsourced relationships as well. As can be seen in Table 8, there appears to be support for H1 since correlations among Top Management Team Involvement and Quality Philosophy and Supplier/Subcontractor Involvement are positively and significantly correlated at the 0.01 level for a 2-tailed test.

Table 8: Person Correlations for n = 63.

	Top Management Team Involvement
Quality Philosophy	.747** .000
Supplier/Subcontractor Involvement	.376** .002

** Correlation is significant at the 0.01 level (2-tailed)
* Correlation is significant at the 0.05 level (2-tailed)

Tables 9, 10, and 11 provide the descriptive statistics for the individual questionnaire items that make up the constructs for H1. It appears that project quality is an important issue that is supported by management and the project teams. However, it appears that the relationship with suppliers/subcontractors is not as strong.

Table 9: Descriptive Statistics for Top Management Team Involvement (n = 63).

Questionnaire Item	1 Strongly Disagree	2 Disagree	3 Neutral	4 Agree	5 Strongly Agree	Mean	Std. Dev.
My organization's top executives assume responsibility for the quality performance of IT projects	3 4.8%	8 12.7%	8 12.7%	**33** **52.4%**	11 17.5%	3.65	1.065
All managers in my organization participate in the quality improvement process for IT projects.	3 4.8%	17 27.0%	14 22.2%	**27** **42.9%**	2 3.2%	3.13	1.008
The goal-setting process for quality of IT projects within my organization is comprehensive.	3 4.8%	11 17.5%	21 33.3%	**23** **36.5%**	5 7.9%	3.25	0.999
My organization's top management has objectives for quality performance of IT projects.	3 4.8%	9 14.3%	12 19.0%	**32** **50.8%**	7 11.1%	3.49	1.030
Importance is attached to the quality of IT projects by my organization's top management in relation to cost objectives.	3 4.8%	9 14.3%	10 15.9%	**36** **57.1%**	5 7.9%	3.49	0.998

Table 10: Descriptive Statistics for Quality Philosophy (n = 63).

Questionnaire Item	1 Strongly Disagree	2 Disagree	3 Neutral	4 Agree	5 Strongly Agree	Mean	Std. Dev.
There is a strong commitment to the quality of IT projects at all levels of this organization.	4 6.3%	12 19.0%	14 22.2%	**26** **41.3%**	7 11.1%	3.32	1.105
People in this organization are aware of its overall mission.	1 1.6%	5 7.9%	7 11.1%	**39** **61.9%**	11 17.5%	3.86	0.859
Members of this organization show concern for the need for quality.	1 1.6%	3 4.8%	8 12.7%	**39** **61.9%**	12 19.0%	3.92	0.809
Continuous quality improvement is an important goal of this organization.	2 3.2%	4 6.3%	17 27.0%	**28** **44.4%**	12 19.0%	3.70	0.961
Managers of this organization try to plan ahead for changes that might affect project performance.	2 3.2%	11 17.5%	17 27.0%	**27** **42.9%**	6 9.5%	3.38	0.991

Table 11: Descriptive Statistics for Supplier/Subcontractor Involvement (n = 63).

Questionnaire Item	1 Strongly Disagree	2 Disagree	3 Neutral	4 Agree	5 Strongly Agree	Mean	Std. Dev.
Suppliers/subcontractors are selected based on quality rather than price.	4 6.3%	10 15.9%	**24** **38.1%**	21 33.3%	4 6.3%	3.17	0.993
My organization's supplier/subcontractor rating system is thorough.	5 7.9%	10 15.9%	**32** **50.8%**	13 20.6%	3 4.8%	2.98	0.942
My organization relies on reasonably few, but dependable suppliers/subcontractors.	2 3.2%	9 14.3%	22 34.9%	**27** **42.9%**	3 4.8%	3.32	0.895
My organization provides education to its suppliers/subcontractors.	7 11.1%	20 31.7%	**20** **31.7%**	14 22.2%	2 3.2%	2.75	1.031
Longer term relationships are offered to suppliers/subcontractors.	1 1.6%	6 9.5%	21 33.3%	**31** **49.2%**	4 6.3%	3.49	0.821
Clear specifications are provided to suppliers/subcontractors.	1 1.6%	3 4.8%	27 42.9%	**30** **47.6%**	2 3.2%	3.46	0.714

H2: Visionary Leadership is Positively Related to Learning.

The second hypothesis focuses on the relationship between visionary leadership and learning. Douglas and Fredendall (2004) used Total Quality Training and Customer Driven Information to represent the Learning construct of the Deming Management Method. As summarized in Table 12, the correlations between Top Management Team Involvement and Total Quality Training and Customer Driven Information are positive and significant at the 0.01 significance level, thus providing support for H2.

Table 12: Person Correlations for n = 63.

	Top Management Team Involvement
Total Quality Training	.589** .000
Customer Driven Information	.461** .000

** Correlation is significant at the 0.01 level (2-tailed) *Correlation is significant at the 0.05 level (2-tailed)

Interestingly, Table 13 suggests that many of the respondents believe that quality training is not a priority, while Table 14 suggests that many tend to feel that there is a stronger focus on the internal or external customer.

Table 13: Descriptive Statistics for Total Quality Training (n = 63).

Questionnaire Item	**1 Strongly Disagree**	**2 Disagree**	**3 Neutral**	**4 Agree**	**5 Strongly Agree**	**Mean**	**Std. Dev.**
Quality-related training is given to all IT project team members.	5 7.9%	**29** **46.0%**	14 22.2%	14 22.2%	1 1.6%	2.63	0.972
Quality-related training is given to IT project managers and other IT project leaders throughout the organization.	4 6.3%	**24** **38.1%**	16 25.4%	17 27.0%	2 3.2%	2.83	1.009
Training is given in the "total quality concept" (i.e., philosophy of organization-wide responsibility for quality) for all IT project team members.	6 9.5%	**31** **49.2%**	16 25.4%	9 14.3%	1 1.6%	2.49	0.914
Training is given in the basic statistical techniques (such as histograms and control charts) to all IT project team members.	16 25.4%	**28** **44.4%**	13 20.6%	6 9.5%	0 0.0%	2.14	0.913
My organization's top management is committed to employee training for quality.	4 6.3%	14 22.2%	**26** **41.3%**	18 28.6%	1 1.6%	2.97	0.915
Resources are provided for employee training in quality.	3 4.8%	20 31.7%	18 28.6%	**21** **33.3%**	1 1.6%	2.95	0.958

Table 14: Descriptive Statistics for Customer Driven Information (n = 63).

Questionnaire Item	**1 Strongly Disagree**	**2 Disagree**	**3 Neutral**	**4 Agree**	**5 Strongly Agree**	**Mean**	**Std. Dev.**
IT project team members know who their (internal or external) customers are.	1 1.6%	0 0.0%	6 9.5%	**37** **58.7%**	19 30.2%	4.16	0.723
IT project team members attempt to measure their customers' needs.	0 0.0%	3 4.8%	10 15.9%	**37** **58.7%**	13 20.6%	3.95	0.750
My organization uses customer requirements as the basis for Quality.	1 1.6%	6 9.5%	8 12.7%	**38** **60.3%**	10 15.9%	3.79	0.883
My organization is more customer focused than our competitors.	1 1.6%	4 6.3%	23 36.5%	**24** **38.1%**	11 17.5%	3.63	0.903

H3: Internal and External Cooperation is Positively Related to Process Management.

The third hypothesis focuses on the relationship between Internal and External Cooperation and Process Management. Douglas and Fredendall (2004) used Management By Fact and Total Quality Methods to represent the Process Management construct of the Deming Management Method. However, this study expanded this concept by including a set of items related to Project and Software Engineering processes. As suggested in Table 15, support for H3 exists as all of the correlations are significant and positive at the 0.01 level of significance.

Table 15: Person Correlations for n = 63.

	Quality Philosophy	**Supplier/Subcontractor Involvement**
Management By Fact	.508** .000	.353** .004
Total Quality Methods	.556** .000	.417** .001
Process Management - Project	.594** .000	.554** .000
Process Management – Software Engineering	.596** .000	.342** .006

** Correlation is significant at the 0.01 level (2-tailed)
* Correlation is significant at the 0.05 level (2-tailed)

Interestingly, the descriptive statistics in Tables 16 and 17 suggest mixed or even lesser support for the use of quantitative data and total quality methods being used or having a great deal of important on IT projects. However, Process Management related to project and software engineering processes in Tables 18 and 19 appears to be much more important or more widely used.

Table 16: Descriptive Statistics for Management By Fact (n = 63).

Questionnaire Item	**1 Strongly Disagree**	**2 Disagree**	**3 Neutral**	**4 Agree**	**5 Strongly Agree**	**Mean**	**Std. Dev.**
Quality data (defects, complaints, outcomes, time, satisfaction, etc.) are available.	5 7.9%	20 31.7%	12 19.0%	**21** **33.3%**	5 7.9%	3.02	1.143
Quality data are timely.	6 9.5%	17 27.0%	**20** **31.7%**	18 28.6%	2 3.2%	2.89	1.033
Quality data area used as tools to manage quality.	5 7.9%	17 27.0%	**21** **33.3%**	19 30.2%	1 1.6%	2.90	0.979
Quality data are available to IT project team members.	4 6.3%	18 28.6%	18 28.6%	**19** **30.2%**	4 6.3%	3.02	1.055
Quality data are available to IT project managers and IT project leaders.	4 6.3%	16 25.4%	13 20.6%	**26** **41.3%**	4 6.3%	3.16	1.081
Quality data are used to evaluate IT project team member and managerial performance.	5 7.9%	14 22.2%	**27** **42.9%**	14 22.2%	3 4.8%	2.94	0.982

Table 17: Descriptive Statistics for Total Quality Methods (n = 63).

Questionnaire Item	1 Strongly Disagree	2 Disagree	3 Neutral	4 Agree	5 Strongly Agree	Mean	Std. Dev.
IT project team members use the basic statistical techniques (such as histograms and control charts) to study their work processes.	14 22.2%	**24 38.1%**	18 28.6%	6 9.5%	1 1.6%	2.30	0.978
IT project team members analyze the time it takes to get the job done.	0 0.0%	8 12.7%	5 7.9%	**45 71.4%**	5 7.9%	3.75	0.782
IT project team members keep records and charts measuring the quality of work displayed in their work area or have access to this information electronically.	7 11.1%	**24 38.1%**	18 28.6%	12 19.0%	2 3.2%	2.65	1.019
Statistical techniques are used to reduce variation in project processes.	12 19.0%	**28 44.4%**	12 19.0%	11 17.5%	0 0.0%	2.35	0.986
Total Quality Management (TQM) procedures (such as brainstorming, cause-and-effect diagrams, Pareto charts) are used to analyze information for process improvement.	10 15.9%	17 27.0%	**23 36.5%**	13 20.6%	0 0.0%	2.62	0.991

Table 18: Descriptive Statistics for Process Management - Project (n = 63).

Questionnaire Item	1 Strongly Disagree	2 Disagree	3 Neutral	4 Agree	5 Strongly Agree	Mean	Std. Dev.
A realistic project plan is developed to outline phases, tasks, and resources to estimate the project's schedule and budget.	1 1.6%	6 9.5%	7 11.1%	**31 49.2%**	18 28.6%	3.94	0.965
Project plans are used to monitor and communicate the project's status to plan.	1 1.6%	4 6.3%	5 7.9%	**35 55.6%**	18 28.6%	4.03	0.879
Qualified supplier/subcontractors are selected and then their progress and performance are tracked by monitoring work products and processes (i.e., acceptance reviews and tests).	3 4.8%	6 9.5%	21 33.3%	**24 38.1%**	9 14.3%	3.48	1.014
Software engineering and project management processes are tailored to fit the current project environment and technical needs of the project.	1 1.6%	3 4.8%	7 11.1%	**39 61.9%**	13 20.6%	3.95	0.812
A proactive approach that includes risk identification, risk assessment, and risk mitigation is used to manage risk throughout all phases of the project.	5 7.9%	10 15.9%	17 27.0%	**23 36.5%**	8 12.7%	3.30	1.131

Table 19: Descriptive Statistics for Process Management – Software Engineering (n = 63).

Questionnaire Item	1 Strongly Disagree	2 Disagree	3 Neutral	4 Agree	5 Strongly Agree	Mean	Std. Dev.
Accurate requirements are documented for developing the project's design and code.	2 3.2%	6 9.5%	7 11.1%	**34 54.0%**	14 22.2%	3.83	0.993
Procedures are in place for obtaining and managing requirement changes to ensure that all approved changes are reflected in changes to the project plan.	2 3.2%	5 7.9%	11 17.5%	**34 54.0%**	11 17.5%	3.75	0.950
Defined life-cycle processes support the technical activities of the project (i.e., evaluate alternatives, design, code, test, document) in order to design, develop, and implement solutions to requirements.	2 3.2%	0 0.0%	8 12.7%	**38 60.3%**	15 23.8%	4.02	0.813
A defined process ensures that system	2	4	10	**36**	11	3.79	0.919

components meet specified requirements (i.e., peer reviews).	3.2%	6.3%	15.9%	**57.1%**	17.5%		
A defined process ensures that the system or system components meet internal or external customer expectations (i.e., acceptance testing).	1 1.6%	3 4.8%	6 9.5%	**36** **57.1%**	17 27.0%	4.03	0.842

H4: Learning is Positively Related to Process Management.

The fourth hypothesis focuses on the relationship between learning and process management. As can be seen in Table 20, support for H4 exists as all of the correlations are significant and positive.

Table 20: Person Correlations for n = 63.

	Total Quality Training	**Customer Driven Information**
Management By Fact	.539** .000	.466** .000
Total Quality Methods	.429** .000	.285* .024
Process Management - Project	.323** .010	.459** .000
Process Management – Software Engineering	.472** .000	.464** .000

** Correlation is significant at the 0.01 level (2-tailed)
* Correlation is significant at the 0.05 level (2-tailed)

H5: Process management is positively related to continuous improvement

Hypothesis 5 focuses on the relationship between Process Management and Continuous Improvement. Support for this hypothesis exists as all of the correlations in Table 21 summarize are positive and significant at the 0.01 level.

Moreover, the descriptive statistics in Table 22 that most of the respondents believe that continuous improvement is an important component of IT project quality.

Table 21: Person Correlations for n = 63.

	Continuous Improvement
Management By Fact	.651** .000
Total Quality Methods	.607** .000
Process Management - Project	.444** .000
Process Management – Software Engineering	.525** .000

** Correlation is significant at the 0.01 level (2-tailed)
* Correlation is significant at the 0.05 level (2-tailed)

Table 22: Descriptive Statistics for Continuous Improvement (n = 63).

Questionnaire Item	1 Strongly Disagree	2 Disagree	3 Neutral	4 Agree	5 Strongly Agree	Mean	Std. Dev.
IT project team members in the organization try to improve the quality of their project work.	1 1.6%	0 0.0%	10 15.9%	**40** **63.5%**	12 19.0%	3.98	0.707
IT project team members in the organization believe that quality improvement is their responsibility.	2 3.2%	3 4.8%	18 28.6%	**32** **50.8%**	8 12.7%	3.65	0.883
IT project team members in the organization analyze their work products to look for ways of doing a better job.	0 0.0%	2 3.2%	24 38.1%	**28** **44.4%**	9 14.3%	3.70	.754
Best practices are identified, documented, and made available to others within the organization.	4 6.3%	5 7.9%	22 34.9%	**27** **42.9%**	5 7.9%	3.38	0.974

H6: Process Management is Positively Related to Project Team Member Fulfillment.

The sixth hypothesis suggests that process management is positively related to a team member's fulfillment with their job. Table 23 suggests support for this hypothesis as well as each of the correlations between process management and employee fulfillment is positively and significantly correlated. In addition, it appears from the descriptive statistics in Table 24 that many of the respondents take pride in their work, enjoy what they do, and find their work challenging.

Table 23: Person Correlations for n = 63.

	Employee Fulfillment
Management By Fact	.324** .010
Total Quality Methods	.347** .005
Process Management - Project	.443** .000
Process Management – Software Engineering	.319* .011

** Correlation is significant at the 0.01 level (2-tailed)

* Correlation is significant at the 0.05 level (2-tailed)

Table 24: Descriptive Statistics for Employee Fulfillment (n = 63).

Questionnaire Item	1 Strongly Disagree	2 Disagree	3 Neutral	4 Agree	5 Strongly Agree	Mean	Std. Dev.
I take pride of accomplishment or achievement from being able to deliver a quality information technology solution.	0 0.0%	2 3.2%	3 4.8%	23 36.5%	**35** **55.6%**	4.44	0.736
In general, I enjoy my work.	2 3.2%	1 1.6%	4 6.3%	27 42.9%	**29** **46.0%**	4.27	0.902
In general, I find my work challenging.	1 1.6%	3 4.8%	4 6.3%	27 42.9%	**28** **44.4%**	4.24	0.893
I am likely to stay with my present organization for the next 12 months (not including planned or unplanned leave of absence or retirement).	6 9.5%	3 4.8%	5 7.9%	17 27.0%	**32** **50.8%**	4.05	1.288
Overall, I have performed the duties of my job well over the past year.	0 0.0%	0 0.0%	2 3.2%	**31** **49.2%**	30 47.6%	4.44	0.562

H7: Continuous Improvement is Positively Related to Project Performance and Customer Satisfaction.

Hypothesis seven focuses on the relationship between continuous improvement and project performance as well as customer satisfaction. In this study, a customer was defined as either being an internal customer (e.g., the human resources department) or an external customer (e.g., a client such as another organization). As summarized in Table 25, support for H7 exists as the correlations are positive and significantly correlated at the 0.01 level of significance.

Moreover, the descriptive statistics in Tables 26 and 27 provide some interesting insight into the status of IT projects. From the descriptive statistics in Table 26, it appears that the ability to meet projects schedules and budgets has improved over the past three years. Moreover, it appears that the majority of respondents believe that the organization's ability to complete project scope or system requirements has remained the same. Table 27 also suggests that internal or external customer satisfaction has improved over the past three years.

Table 25: Person Correlations for n = 63.

	Continuous Improvement
Perceived Project Performance	.396** .001
Perceived Customer Satisfaction	.373** .003

** Correlation is significant at the 0.01 level (2-tailed)
* Correlation is significant at the 0.05 level (2-tailed)

Table 26: Descriptive Statistics for Perceived Project Performance Over the Past 3 Years (n = 63).

Questionnaire Item	**Much Worse**	**Worse**	**Same**	**Better**	**Much Better**	**Mean**	**Std. Dev.**
Ability to meet project schedules	0 0.0%	7 11.1%	23 36.5%	**27** **42.9%**	6 9.5%	3.51	0.821
Ability to meet project budgets	2 3.2%	7 11.1%	23 36.5%	**26** **41.3%**	5 7.9%	3.40	0.908
Ability to complete project scope or system requirements	3 4.8%	4 6.3%	**25** **39.7%**	23 36.5%	8 12.7%	3.46	0.964

Table 27: Descriptive Statistics for Perceived Customer Satisfaction Over the Past 3 Years (n = 63).

Questionnaire Item	**Much Worse**	**Worse**	**Same**	**Better**	**Much Better**	**Mean**	**Std. Dev.**
Overall satisfaction of the customer	1 1.6%	8 12.7%	23 36.5%	**26** **41.3%**	5 7.9%	3.41	0.873
Perceived value of the delivered project to the customer	0 0.0%	5 7.9%	**25** **39.7%**	**25** **39.7%**	8 12.7%	3.57	0.817
Potential for future work with the customer	1 1.6%	3 4.8%	22 34.9%	**26** **41.3%**	11 17.5%	3.68	0.877

H8: Project Team Member Fulfillment is Positively Related to Project Performance and Customer Satisfaction.

Lastly, hypothesis eight suggests that project team member fulfillment is positively related to project performance and customer satisfaction. The correlations in Table 28 are also positively and significantly correlated and therefore provide support for H8.

Table 28: Person Correlations for n = 63.

	Employee Fulfillment
Perceived Project Performance	.397** .000
Perceived Customer Satisfaction	.406** .000

** Correlation is significant at the 0.01 level (2-tailed)
* Correlation is significant at the 0.05 level (2-tailed)

CONCLUSIONS

Based on the results of this study, it appears that there is strong support for applying the teachings and ideas of W. Edwards Deming to IT project quality management. While the correlation analysis provides support for the Deming Management Method, the descriptive statistical analysis provides some insight into how many of Deming's ideas and teachings are being applied explicitly or implicitly in the development of information systems.

The application of the Deming Management Method to IT projects provides a new area of study for IS researchers. This study provides a first step for adapting and expanding the model to understand the role software development tools play in supporting the quality initiative for IT projects. For example, Post and Kegan (2005) investigated current system development trends and report that certain tools, such as a database management system, make it significantly more likely that projects will be completed on time and within budget. In addition, the role of statistical analysis is a tenant of Deming in order to manage by fact. Subsequently, previous research such as a study by Anand and Chung (2005) suggest that engineering IT support issues can be well managed using statistical process control chart (SPC) to help engineering IT management determine whether a support incident is in control. Moreover, Allison and Merali (2006) describe how statistical process improvement (SPI) programs can be understood as a form of active learning whereby various project team members reflect upon their actions, make sense of the current context, and then design processes to best suite their needs at that time. Another consideration may be on the geographical dispersion of project team members and subcontractors as many project processes are outsourced or off-shored. For example, Chen, Romano, and Nunamaker (2006) contend that projects today involve members from different geographical locations and suggest a collaborative project management approach to better manage distributed projects.

For organizations, greater insight into the application of the Deming Management Method may increase the likelihood of projects meeting scope, schedule, and budget objectives, while improving internal or external customer satisfaction. More specifically, the importance of leadership may be critical to a learning IT organization that focuses on both project and software engineering processes in order to support continuous learning and encourage project team member morale. This is also supported by prior research by Wu, Hwang, Chen, and Jiang (2002) who report that a more mature software development process reduces certain risks in the project and supports better project performance.

However, all studies have limitations, and this study is no different. For example, the measures used in this study were based on the respondents' perceptions such as perceived project performance and perceived customer satisfaction. Future research should attempt to collect more objective information about project performance and direct customer perceptions.

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