Reducing I.T. Project Management Failures: Early Empirical Results

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Abstract

Failures rates of Information Technology (I.T.) projects remain high, even after decades of efforts to reduce them. Most efforts to improve project success have focused on variations within the traditional project management paradigm, such as advanced by the Project Management Body Of Knowledge (PMBOK). This paper reports on early empirical results into project (management) success or failure factors stemming from the traditional paradigm as well as from Value-Driven Change Leadership (VDCL). The early results points to several success factors stemming from the traditional project management paradigm as well as from VDCL.

1. Introduction

In this paper we report on empirical research that aims to reduce failure rates of I.T.-intensive projects. We hope that the conference reviews and discussions will further improve this research. In this paper, we first present a review of the literature about I.T. project failure rates over the past few decades. We then summarize Value-Driven Change Leadership (VDCL), a new set of principles about project management, as presented, e.g., in [22]. Next, we describe the results of our empirical work completed thus far. Finally, we describe further research.

2. Literature review

Various researchers have grappled with the question of what constitutes project success or failure. Following Drucker's [16] distinction between efficiency ("doing things right") and effectiveness ("doing the right things"), we distinguish the "efficiency" and "effectiveness" schools of thought. The efficiency school of thought focuses on the project's *management*, as evidenced by criteria such as activities, resources, schedules and costs, see, e.g., the Project Management Body of Knowledge ("PMBOK") [45]. The efficiency school focuses on takes an internal view of the project [42]. The effectiveness school of thought focuses on the project's stakeholders, *outcomes* and *end products* being successful, as evidenced by criteria such as how much/well the end product is used, how well it corresponds to the original requirements, and resulting profits [14]. The effectiveness school takes an external view of the project. Some authors argue for a combination of efficiency and effectiveness measures [3], with different measures appropriate at different stages of the project life cycle [43].

2.1. Failure rates have been high for decades

Researchers such as Robert Glass have chronicled various projects that failed [20]. The Standish Group reported for 2010 that 24% of I.T. projects were canceled before they were completed, 44% were completed and operational but were over budget, late, and/or completed with fewer features and functions than originally specified; 32% were delivered on time, on budget and met requirements [51]. (It must be noted, however, that some researchers have raised issues with the Standish reports, e.g., [17], [24]). Research in the UK found that 9% of projects had been abandoned and that, on average, projects overshot budget by 13% and schedule by 20% and underdelivered on scope by 7%. Of course, project termination does not necessarily equal project failure. Certain projects may curtail further losses by terminating, and "If you don't try some risky projects, you'll lose your competitive edge" [9]. The probability of failure of I.T. projects appears to increase with project size as measured, e.g., in person-months [48] or in function points [23].

Concern about (high) project failure rates has been raised for decades. In the late 1980's, research in the U.S.A. found that 16.5% of software projects "rarely or never have cost overruns" while "fully 41% always or usually do" with cost overruns

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averaging 33% [40]. In the early 1980's, research in the U.S.A. found that among I.S. development projects the median cost overrun was 33.5%, the median overrun in person-days was 36%, and the average schedule overrun was 22% [23]. That same research found that 17.5% of software projects are "rarely or never delivered late, while 32.9% are always or usually late." In the 1970's, Hank Lucas wrote his Ph.D. dissertation on "Why Information Systems Fail" [28]. In 1968, the NATO-sponsored conference that cointed the term "software engineering" already included discussions about "software crisis" and "software failure," noting that "it is large systems that are encountering great difficulties" [33]. As reported in [46], one of the conference participants, J. Licklider, had reported that "at one time, at least two or three dozen complex electronic systems for command, control and/or intelligence operations were being planned by the military. Most were never completed. None was completed on time or within budget." Hence, I.T. project failure rates appear high for several decades, despite efforts to reduce them during that time.

2.2. Failure factors and success factors

During the past several decades, numerous studies have tried to determine factors influencing I.T. project success and/or failure. Several factors were found to contribute to project success, including clearly defined goals and requirements, executive support, detailed up-to-date plan, good communication with stakeholders, skilled/qualified/sufficient team, user/client involvement, project organization, project leadership, scope management, realistic estimates of completion time, reassessment and handling of risks throughout the project, tools, timely progress feedback, and adaptability to unexpected events. See, for example, [7], [8], [13], [19], [35], [37], [43], [50], [58]. However, a review of 63 publications found limited agreement among them as to which factors matter for project success [19]. Of course, that the project be the "right one" for given requirements and expectations is also important to project success [30]. Other factors were found to contribute to project failure, e.g., lack of general agreement on project goals, use of an inappropriate software development methodology, dissimilarity to previous projects, requirements volatility, and inadequate technology base or infrastructure ([18], [54]). Some factors contribute to project success or failure dependent on their presence or absence, e.g., clearly established success criteria, goal commitment of the project team, adequate project team capability [6].

A number of these factors and associated management techniques have been part of the traditional way of thinking about project management, as promulgated, e.g., in PMBOK. PMBOK focuses on activities and resources and focuses on on-time and on-budget completion of project activities. Critical Chain [21], a related method, focuses on bottlenecks in critical resources. PRINCE2 [36], which focuses more product-based planning with a Product Breakdown Structure (PBS), also has a significant overlap with PMBOK.

2.3. Project management paradigms

Additional success- or failure factors stem from other ways of thinking about project management. At least six different "perspectives" on project management have been recognized [27], with the task perspective dominating PMBOK. The other perspectives are the leadership perspective (team effectiveness, leadership styles), the system perspective (e.g., inadequate technology base or infrastructure), stakeholder perspective (e.g., agreement regarding project goals), transaction cost perspective (e.g., goal commitment of the project team), and the business-by-project perspective (e.g., focus on project results).

To improve project management practices, managers can engage in single-loop learning "changing actions" and/or double-loop learning "altering the governing variables" ([4], p.8-9). In single-loop learning, project managers might change action regarding different activities on the project's critical path. In double-loop learning, managers question the relevancy of their existing way of thinking, and, rather than focus on activities on the critical path, might change perspectives, e.g., focus on the project's intended business results.

3. Value Driven Change Leadership

Recently, a new project management paradigm has been described called "Value-Driven Change Leadership" (VDCL) [22]. VDCL is a framework for thinking about the management of I.T. projects, whether done individually or in the context of a program and/or portfolio of projects. While VDCL overlaps with frameworks for program management and portfolio management, it focuses on *project* management. Although the success factors for I.T. projects may be different than those for other projects [32], the principles of VDCL might be applicable to non-I.T. projects as well [22].

3.1. VDCL principles

VDCL consists of 11 principles organized into three overlapping themes. The three themes are "value-added over budget/schedule," "business solution over architecture framework," and "human change over repeated activities." We have adopted this "x over y" formulation of these themes from the Agile Manifesto (agilemanifesto.org) to emphasize new ways of thinking while not discarding old ways. The VDCL themes and principles are described next.

3.1.1. Value-added over budget/schedule. According to traditional project management metrics, a project that is completed ahead of schedule and under budget is a success. However, if that project's costs exceed the benefits, executive management may well consider it unsuccessful. Also, according to traditional project management metrics, a project that is completed behind schedule and over budget might be labeled as a failure. However, if a project's benefits exceed costs, executive management may well consider successful. VDCL emphasizes projects adding value to an organization. As one executive we know remarked: "Firms invest in I.T. to create value, not software." Another said: "There are only 'business' projects, some have more I.T. than others."

Delivering benefits and managing value to the customer have been recognized as important activities for project leaders, see, e.g., [2], [13], [26], [29], [55], even across different stakeholders [50]. Accordingly, VDCL views the project manager as responsible for the business results obtained from the projects, an "intrapreneurship" view as advocated in [53]. According to this view, project leaders should balance the project schedule and cost (as always), along with benefits, tangible (e.g., financial return), and intangible (e.g., company image), see [31], [41].

Three principles address the theme of value-added. VDCL views value-added as the net change in financial results due to the organization's and/or third-party stakeholders' adoption of the project's end product (for example, employees, customers, or business partners making productive use of a new I.T. system). While VDCL acknowledges that projects often provide intangible results such as second order effects, its focus is on business results that are quantifiable and measurable. For example, the value of "compliance" may be quantified by the cost savings of non-compliance. "Opportunity expansion" may be quantified using option valuation. As one executive put it: "If a project is expected to generate largely intangible results, I will provide largely intangible investments."

The first principle, which we label V1, is "measuring business results over measuring process conformance." According to this principle, in order to measure business results, it is important that all key stakeholders understand and agree on what the project's value-added and outcomes should be, and that they agree on clear success metrics. Furthermore, everybody working in the project (team members, subcontractors, etc.) should also understand and agree with the value-added and outcomes and related success metrics. In order to align incentives towards those metrics, project participants should have a personal stake in the success or failure of the project.

The second principle (V2) is "managing the business case over abandoning the business case." Before they start, many projects are approved on the basis of a business case. Once approved, projects are often managed on the basis of budget and schedule, no longer on the basis of the business case. In effect, the business case is often abandoned after the project is approved. According to VDCL, the business case should guide the project towards a decision to approve or reject the project (to clarify success metrics, evaluate project alternatives), but also during its execution (to evaluate change requests and trade-off decisions), and after the end-product has been delivered (to analyze actual business results). At the same time, we are not optimistic about many firms' desire or ability to keep track of their projects' business results. Unfortunately, such non-tracking may contribute to continued project failures, because it hinders learning what the real impact was of a project on business results.

The third principle (V3) is "quantifying the financial impact of risks over identifying a list of risks." This principles implies that qualitative and quantitative risk analysis as described by PMBOK are not sufficient and that the impact of (a combination of) risks should also be analyzed as to their impact on the long-range financial results of the projects.

3.1.2. Business solution over architecture framework. When I.T. projects disregard an explicit architecture of the end product, they may contribute to the rate of project failures. The importance of architecture is only sparingly acknowledged in the literature, e.g., in texts on system architecture: "good architectural design has always been a major factor in determining the success of a software system" [49].

Architecture is important for project management because it impacts many knowledge areas in PMBOK (e.g., scope management and integration management). Although project managers do not

need to be architects themselves, they do need to ensure that architecture of the end product gets adequate attention in the project and is reflected in the project plan [38]. After all, in the words of one I.T. architect we know: "Ignoring the architecture of a system is rather like ignoring the core of a skyscraper. Skyscrapers are not built wall by wall, but floor by floor, around the core." We define architecture as a representation or description of the structure of the specific end product, which includes 1) the configuration of modules (of the system) that perform important functions that are common within the end-product: by "common" we mean functions that are needed frequently by end-users and/or by other functions, or functions that are similar in functionality. 2) the relations (Input/Output and Control) among the modules. 3) the specific syntax of the interfaces to the modules, i.e., the specification of how modules should be accessed or invoked. This view advocates systems thinking as the basis for project management [19], [34]. It is important to note that by architecture we do not mean infrastructure. Infrastructure (e.g., .NET) is a super system that offers functionalities that can be used by the project's end product.

Four principles address the theme of architecture. The first (A1) is "attending to architecture over ignoring architecture." System architecture in many projects is either ignored or inadequately addressed [22]. Rather than tailoring architecture to the desired end result, the preexisting architecture is adopted by default. Architecture should be a key aspect of the end product and, therefore, of the project plan.

Principle 2 (A2), an extension of A1, is "designing business solutions over debating generic frameworks." Some projects address architecture by debating generic technology frameworks (e.g., SOA, Zachman, or .NET). Instead, VDCL advocates that the focus be on a specific solution designed for specific business goals (as addressed in the value theme) with a specific structure.

The third principle (A3) is "releasing frequently over releasing with one big bang." While PMBOK neither requires nor explicitly suggests multiple releases of the end product, other approaches such as Agile Development [10] and SCRUM [11], [52] do. These latter approaches essentially assume that all releases of a system are based upon a stable architecture. The VDCL panel argued that a first release should establish the architecture for all subsequent releases, i.e., the first release builds on an existing architecture or delivers a new architecture. Each release delivers incremental business benefits by addressing the highest (remaining) priorities and risks, business as well as technical risks.

Each architecture will have advantages and disadvantages and different risks associated with it. Consequently, an important principle, "flexible architecture" (A4), is that alternative architectures be developed before the project starts and possibly built into the end product [53]. One way to implement this principle is to conduct architectural reviews early in the project to assess architectural alternatives and the project's risk and likelihood of success/failure [5].

3.1.3. Human change over repeated activities. By definition, a project is about something new. Introducing something new into an organization causes organizational change. In other words, organizational change is inherent in projects and should be a part of project management. What is organizational change all about? To paraphrase the mantra of President Clinton's presidential campaign, "It's the people, stupid." It is about human change.

Four principles address the theme of human change. The first (L1) is "changing organizations over delivering products." Simply delivering an end product is not sufficient; the organization must be prepared to adopt the new end-product for effective use. Organizational change may involve changes in jobs, workflows, organizational structures, responsibilities, collaboration with others, required skills, etc. Preparing the organization for change requires, e.g., executive support, on-going communication, training, managing resistance, or tying rewards to the project's value-added [12], [15].

The second principle (L2) is "improving activities over repeating activities." When projects continue to fail over time, that suggests a failure to learn from failures [1]. Instead of repeating the same project activities, they must be replaced or improved over time. This implies that the project should (be allowed to) take time to learn from previous projects, contemporaneous projects and from the project itself. Project team members must take time to evaluate project activities, learn from other projects, and explore new ideas for improvement [13]. The third principle (L3) is "developing human relations over interchanging resources." This principle says that people should not be viewed as interchangeable resources. Instead, they should be viewed as a "whole person," with unique skills and experiences, personal as well as professional. Principle 4 (L4) is "finding common ground over negotiating differences." Project activities get done on the basis of trust and common ground [25], [47], [56]. This principle advocates "agree-to-agree," i.e., find items on which there is agreement and work on those.

Over time, trust and fruitful human relations develop that enable things to get done.

3.2. Different from traditional paradigm

If the traditional paradigm as represented by PMBOK can be characterized as "managing activities towards on-time/ on-budget based on the PERT chart of tasks," then VDCL can be characterized as "changing people towards adding value based on the architecture of the end-product." The VDCL paradigm appears applicable for projects that construct end products *and* make design decisions that positively affect the project's value-added. In traditional construction projects, e.g., of submarines or buildings, the end products are constructed from detailed blueprints that are largely completed before construction begins. During construction, builders can make only minor design changes. In I.T.-intensive projects, however, detailed designs may not exist, and during system construction, programmers and analysts make many design decisions, including about key functionalities of the end products. This raises the issue of what the "scope" of the project is. VDCL principles apply from the phases of project approval, planning, and definition, i.e., before design, all the way through project justification after installation. VDCL views delivery of business results as the overarching objective of the project, and consider anything that significantly affects the business results to be "in scope."

4. Research hypothesis

This study was aimed at testing the extent to which various factors stemming from the traditional project management paradigm (PMBOK) as well as from the new paradigm (VDCL) influence project success. We recognize that traditional methods of project management intend to increase project success, although they are largely concerned with activities, schedules and budgets, i.e., with project *efficiency*. Success also depends on the extent to which project end-items meet requirements and satisfy customer needs, i.e., on the end-item's *effectiveness*. We are interested in the extent to which PMBOK's knowledge areas as well as VDCL's principles contribute (or not) to project success. We recognize that other elements may also affect project success, such as size of the project or experience or gender of the project manager. We operationalized each PMBOK knowledge area and each VDCL principle as well as project (manager) characteristics into questions on an interview questionnaire. One or more of such questions in turn represents a factor that may (or may not) contribute to greater project success. That is, we view each factor as an independent variable and view project success as the dependent variable. Details about the questionnaire, factors and variables are described later in this paper. In statistical terms, the hypotheses are: *For each factor i:*

H_{0i}*: Factor i is not associated with project success.*

H_{1i}*: Factor i is associated with project success.*

To test these hypotheses, we interviewed project managers about projects that were completed some time ago. We chose to do this to enable us to collect data of project outcomes (our measure of success).

4.1. Independent variables

We based our questionnaire on the one developed by [22]. Each statement generally corresponds to one factor, i.e., one independent variable. (The Appendix to this paper shows selected questions from our questionnaire). For each statement, respondents are to rate their (dis-)agreement using a 7-point ordinal Likert scale. Each of the 30 statements on the questionnaire is about a project management practice that corresponds to a VDCL principle or theme (the latter to enable statistical analysis with coarser variables), or to a knowledge area from the fourth edition of PMBOK. (The fifth edition created a separate knowledge area called "stakeholder management" which had been part of "communications management").

Besides knowledge areas, PMBOK describes many project management processes (activity sequencing, activity resource estimating, cost control, etc.) — an average of five processes per knowledge area. We considered modeling these processes as independent variables, but rejected it since that would have greatly increased the number of statements, and risk a significant reduction in the response rate.

We considered using multiple statements to represent each independent variable, e.g., three statements per factor, but rejected it also. While that might have increased validity, it would make the resulting number of statements (more than 100) very large and, as a result, greatly reduce the response rate. With only one statement per variable, the level of granularity of statements in the questionnaire is still similar to that of other well-known research studies, e.g., [44], [50].

4.2. Dependent variables

We collected various data, based upon which the dependent variable can be conceptualized in two

different ways. The first way is *project outcomes*, the second way is *process efficiency*. Regarding project outcomes, we collected data about the degree to which: a) the end product is used as intended, b) the project contributed to the organization's value-added (taking into account all costs and benefits), and c) how much intangible benefits exceeded tangible benefits. Regarding project efficiency, we collected data about expected and actual elapsed time of the project schedule, expected and actual budget/cost, and expected and actual person hours of the project's labor resources (regardless whether such labor was on the payroll of the organization or of any third parties, such as consultants).

4.3. Project-related characteristics

Since a project's success is likely to be influenced not only by VDCL principles and PMBOK knowledge areas, but also by various characteristics associated with the project itself, we collected data about characteristics of the project, the project manager, and the organization for which the project is performed. Project characteristics include three measures that usually appear in the project's original business case or similar project justification at the start of the project: project duration (elapsed time), project total expenditures (in $US), and incremental benefits (cash receipts). For these measures, we collected data about expected and actual values, if available. Data about characteristics of the project manager includes gender, number of years of project management experience, whether the manager has a Project Management Professional (PMP) certification, and whether the project manager reported to I.T. or a business function. Data on characteristics of the organization for which the project is performed includes the organization's age and revenues, the number of employees, the industry or industries in which it operates, and whether it is for-profit (publicly-traded, or privately-held), not-for-profit, or governmental.

5. Research methodology

Initially, we planned to send the interview questionnaire as an electronic survey to the Chief Information Officers (CIOs) of a large number of organizations in the Chicago area. We wanted them to identify medium-sized I.T.-intensive projects for which a business case or similar justification was approved before the project started. We define medium-sized projects as having a duration (elapsed time) of between one month and one year, with a peak number of project personnel between three and 50. "I.T.-intensive" means that Information Technology was a substantial part of the project's end product. We did not seek projects for which the original justification was primarily the project's option value and/or its intangible results.

We wanted each CIO to identify one pair of I.T. intensive projects, with one project that was widely seen within the organization as successful and one project that was widely seen as unsuccessful. Then, each CIO would forward the questionnaire to the project manager(s) of the successful and the failed project. In this way, we wanted to minimize sample bias as to project success or failure (and have the same 'n' for successful and unsuccessful projects), and also wanted the dataset to contain considerable variability in the values of the dependent variables. At same time, within each pair there would be less variability in the projects' industry, organizational culture, and other characteristics.

Initially, to gauge interest, we asked a handful of CIOs that we know whether they would be willing to have their organization's project managers participate in our research. To a person, they said they would not forward an electronic survey to project managers in their organization. Instead, they said that would be happy to identify a pair of projects, one successful and one unsuccessful, and make the respective project manager(s) available, but only if we came and interviewed the project manager(s) *in person*.

In order to minimize time commitment on the part of the project managers and their organizations, and, therefore, increase the chance of their participation, we decided to collect information from the project managers only and not from other stakeholders, e.g., users, the organization's customers, the business executive who was accountable for the project, team members, etc. This would most likely have provided a richer 360-degree view of the project [57], but is beyond the scope of this phase of our research.

Perhaps not surprisingly, soliciting participation from CIOs of large(r) organizations turned out to be time consuming. In one case, for example, the CIO of one organization was supportive but requested approval from the legal department. After eight months, the legal department would not approve participation in our research by the organization's project managers, despite IRB approval of our research by our university, and despite the project manager's right to not divulge answers to particular questions.

5.1. Sample

Thus far, we have been able to collect data about a pair of projects from each of eight organizations,

i.e., from 16 projects. All eight organizations are Chicago-based and are from six different industries (Utilities, Manufacturing, Education, Healthcare, Insurance, and Consumer Goods), profit and non-profit. On average, the organizations are 106 years old, have four billion dollars of revenue and five thousand employees. Project managers had an average of 13 years of experience in project management, were 54% male, 46% female, and 16% had a PMP®, the rest did not.

6. Statistical Analysis

Our research is ongoing, which is why this paper describes "early" empirical results. Given the number of cases in our current dataset, we cannot rely on statistical analyses that require a larger number of observations or a normal distribution of probabilities (of averages). Therefore, we explored the data using non-parametric statistical analyses. By applying non-parametric tests with a small n we may not identify results that more-sensitive analyses might uncover. However, the results from this early study may well be robust for larger n and more-sensitive techniques, such as components-based statistical analysis for formative constructs [39], e.g., partial least squares (PLS).

Since we collected a pair of projects from each organization, variability is reduced in various organization-specific factors such as industry, organizational culture, executive leadership and the like. Some pairs of projects (successful and unsuccessful) were even managed by the same project manager. At the same time, such variability is not reduced to zero since, within each pair, the projects may have been executed at different times, in different departments, for different units in the organization, etc. However, we assume minimal variability of within-organization factors, and, therefore, applied paired-sample statistical tests.

We applied the sign test and the Wilcoxon signed rank test. Given the small n, we used Excel to "manually" calculate the probabilities that the actual observations fall inside or outside of a rejection area, which, under the null hypothesis, is determined by a binomial probability distribution with p=0.5. That is, under the null hypothesis, the probability that a given project management practice was associated more with successful projects than on unsuccessful projects is 0.5.

6.1. Preliminary results

Interestingly, we were unable to collect many financial data. Among the sixteen projects for which we collected data, only two tracked specified expected benefits in dollar terms and only one tracked actual benefits after delivery of the end item, resulting in only one organization out of eight that tracked benefits for at least the pair of projects we studied. Similarly, only half the project pairs reported expected and actual project costs. Several of the others could not report costs because they do not track labor costs of the organization's personnel that worked on the project. For the nine projects for which we have sufficient data, seven cost more than expected, although the overrun was smaller for the successful project than for the unsuccessful one in three pairs. Similarly, for ten projects for which we have sufficient data, seven took longer than expected, although the overrun was smaller for the successful project than for the unsuccessful one in three pairs.

We knew from the CIOs, who each had selected one pair of projects within their organization, which project was widely viewed within the organization as successful and which one as unsuccessful. We reviewed the data we gathered from the project managers, in particular the question about the project's contribution to the organization's value-added (taking into account all costs and benefits). Aside from one pair with missing data, the project manager(s) assigned a higher score on that question for the successful project as compared to unsuccessful project within all pairs. The same was largely true for the questions about whether the use of the end-item was (not) as intended and whether the intangible benefits did (not) exceed the tangible benefits. For each of these two questions, the project managers scored the successful project higher than the unsuccessful one, with the exception of one (different) pair for each question. Consequently, the project managers' data are largely consistent with the CIOs' views as to success or failure of the project, which we took as the determining view of success or failure of the projects.

For each pair of projects, we subtracted the Likert score for each factor on the unsuccessful project from the Likert score for the same factor on the successful project. This indicates whether, e.g., cost management was applied more (or less) on the successful project as compared to the unsuccessful project within the pair. The statistical results below are based on on the Likert-score differences.

We identified three factors that were associated with successful projects according to the both the sign test and the Wilcoxon tests ($p<0.01$; one-tailed[1]):

[1] In the remainder of this paper, significance level will be one-tailed, unless noted otherwise.

Communications/ expectations management; scope management, and establishing the architecture of the end-item by release 1. The first two are factors from PMBOK, the latter from VDCL. Three additional factors were similarly associated, albeit with a lower statistical significance ($p< 0.10$ on the sign test and $p<0.05$ on the Wilcoxon test): Agreement on the project's purpose, the end-item's architecture is reflected in the project plan, and time/ schedule management. The first two are factors from VDCL, the latter from PMBOK.

Furthermore, we found seven more factors that are associated with successful projects, but with statistical significance on either the sign test or the Wilcoxon test. Three factors ($p<0.05$ on only the Wilcoxon test) are: Human change over repeated activities, focus on agree-to-agree and common ground, and executive sponsorship. The first stem from VDCL theme, the latter from PMBOK as well as from VDCL. Two other factors ($p<0.1$ on only the Wilcoxon test) are: Cost/ budget management and giving team members a stake in the project. The former stems from PMBOK, the latter from VDCL.

Finally, we found two factors with statistical significance on only the sign test: Keep the business case updated throughout the project ($p<0.05$) and develop person-to-person relations ($p<0.1$), both VDCL factors.

6.2. Limitations

Various limitations of this study (so far) have been described earlier in this paper. We summarize them here: A relatively small number of projects in our data set, data are self-reported by project managers only. Because of the small number of projects, the statistical tests are non-parametric. We used tests for data that is paired-sample. Last, but not least, "association" (of project management practices with project success or failure) is not causation.

7. Conclusions

This study identified several factors that appear to be associated with project success. The factors stemming from the traditional (PMBOK) paradigm are: executive sponsorship, communications/ expectations management, scope management, time/ schedule management and cost/ budget management. In addition, we found various factors stemming from the three themes of VDCL: Managing value/ outcomes (agreement on the project's purpose, give everyone a stake in the project and keep the business case updated throughout the project), human change (focus on agree-to-agree and common ground and people-to-people relations) and architecture of the end-item (reflect the end-item architecture in the project plan and establish the architecture by the first release).

While this list of factors may change with data about additional projects, it does suggest that project management practices stemming from PMBOK *and* VDCL paradigms are associated with project success, i.e., reduce I.T. project failures. This study was not designed to ascertain the percentage of I.T. project failures (or any increase or decrease in failures due to various project management practices), so that is left for further research.

7.1. Implications for practitioners

This study suggests that project managers might emphasize certain traditional PMBOK practices that seem strongly associated with I.T. project success, namely executive sponsorship, communications/ expectations management, scope management, time/ schedule management and cost/ budget management. At the same time, project managers might consider supplementing such practices with others from all three themes of VDCL. First, to manage value/ outcomes of the project as well as the trade-off between value/ outcomes and cost/ budget. Second, because, by definition, a project introduces something new into the organization, project managers should manage the human change and seek common ground with various stakeholders. Finally, project managers should reflect the end-item architecture in the project plan and establish the architecture by the first release.

8. Further research

This paper reports on early empirical results of a relatively small number (16) of projects. Hence, a critical next step is to collect data on additional projects. A larger data set will then also allow us to apply more sophisticated statistical analyses, as compared to the non-parametric tests we ran for this study. Subsequent phases may consider perspectives from additional stakeholders beyond the project manager, e.g., executive sponsors, customers, business partners, etc. Another avenue of further research is to collect reliable statistics on the percentage of project successes and failures, as dependent on various project management practices (not) applied on such projects. Hopefully, such statistics would add to our insights as to how to certain project management practices cause (or at least contribute) to an increase in project successes or a reduction in project failures.

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Appendix: Interview questionnaire items

This Appendix shows selected statements representing various PMBOK knowledge areas and VDCL principles. Respondents rated the statements on a 7-point Likert scale from strongly disagree to strongly agree.

1. From beginning to end, the project effectively managed expectations of all the stakeholders.
2. From beginning to end, the project's scope was managed effectively.
3. From beginning to end, the project was managed to stay within an approved schedule or timeline of required activities and their estimated duration and resource requirements.
4. As of the project's first release, the specific architecture of the end-product(s) was set.
5. From beginning to end, the project was managed effectively to stay within an approved budget of estimated costs.
6. The project plan adequately reflected the end-product's architecture, i.e., common modules, interfaces among them and interfaces with underlying infrastructure.
7. From beginning to end, the project focused on people having to change.
8. The project leadership focused on agreeing-to-agree and finding common ground.
9. From beginning to end, higher-level executives / managers actively sponsored the project.
10. The project leadership focused on people-to-people relationships/interactions.
11. All team members felt they had a stake in the success or failure of the project.
12. From beginning to end, the business case was kept up-to-date and the project stayed focused on achieving it.
13. From beginning to end, all stakeholders agreed on, and all team members understood, the project's purpose and measures of value-added.