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Understanding Construction Project Team Dynamics and Performance Through Personality Profiling

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ABSTRACT: The construction industry is a significant part of the US economy, leading to interest in maximizing project outcomes to deliver high value - interest that is reflected through the significant volume of research conducted in academia and the construction industry regarding cost and schedule control, productivity, project delivery, and procurement. However, there is a lack of research that specifically investigates the dynamics of project teams on project success in a quantitative and repeatable manner. This paper presents the results of a study that performed quantitative analysis of project teams' personality profiles, dynamics, and traits using a commercially available personality assessment tool and how those factors played into a project's financial success. To achieve this, the researchers partnered with a general contractor in the Midwest region of the US to collect data on their projects, labor, and the personality assessments of their employees. Three primary deliverables were sought: 1) An understanding of personality profiles of the study company; 2) Direct correlation between the success metric and particular personality traits; 3) An expanded correlation between the success metric and additional independent variables. Through significant data collection and statistical analysis, this study indicated a correlation between project success, which was measured by Change in Margin (CIM), and the team's personality profiles. The results of this study indicate that informed team selection, alongside proper understanding of project characteristics and employee personalities, can push correctly structured teams to follow the best practices of previously successful teams and realize a more successful project.

1. INTRODUCTION

For many construction projects, life begins as a series of specifications and drawings solicited for bid or proposal. However, it is not until the project team coalesces and the project begins to pick up steam that a project truly feels alive. The project team's members may encapsulate a cross-functional snapshot of an organization, as a large-scale project will involve stakeholders from nearly every business unit - and in successful projects, a factor frequently cited as contributory to that success is the 'great team.' But, naturally, forward-minded contractors wondered if the effect of a project team could be quantified, measured, and forecasted in such a way that it could be leveraged for improvement. In a meeting with members of the Construction Engineering and Management program at the University of Wisconsin - Madison, executives from a major construction firm issued this challenge.

Construction typically averages between three and five percent of the U.S. gross domestic product (Kolmar, 2023). However, its impact is felt across the nation and the world - through constructed facilities, housing, infrastructure, employment, and beyond. Yet, the industry suffers from stagnant-to-declining productivity, while other comparable industries realize gains (Goolsbee & Syverson, 2023). Volumes have been written by academics and industry thought leaders alike that tout various methods of improvement in productivity, efficiency, or effectiveness; but these volumes more often than not concern the means and methods of execution (such as labor productivity, cost and schedule, or project delivery). While some academic studies have in the past conducted analysis of team dynamics and project success that considered some

personality-related factors (Phua & Rowlinson, 2004) (Scott-Young & Samson, 2007); they did so via surveys and case studies, which lacks the efficiency and consistency of a quantitative model or test. Additional studies attempted to correlate project management practices to project success but did so across professions (Müller & Turner, 2007) (Papke-Shields et al., 2010), limiting their efficacy in a construction context

In the absence of clear and publicized research from academia or industry, companies have taken efforts to understand employee behavior and team dynamics into their own hands. One frequently employed method is personality assessments, which has become a two billion dollar industry in the U.S. and continues to grow (Goldberg, 2023). Managers use these assessments in an effort to better understand team cohesion and interaction - and some firms even use them to make hiring and career development decisions. It has been estimated that over 100 million workers take some form of personality assessment annually (Ibid).

It is thus apparent that using a vehicle similar to a personality test to capture data about project team members has merit, since the form of assessment is familiar both to the employees and to the managers, increasing buy-in. Building upon that data collection vehicle with two parallel statistical analysis efforts will deliver to the industry an actionable understanding of project team qualities and their quantitative impact on project success, as well as an outline of how different project characteristics impact project success. To achieve this, the researchers partnered with an ENR top 100 general contractor in the Midwest to collect data on their projects, labor, and the personality assessments of their employees.

The research team focused on a particular personality profiling method, the Drake P3©, as it was compulsory for all employees at the company included in this study. The Drake P3© method is based upon trait theory and measures four basic traits: Dominance, Extroversion, Patience, Conformity (Lanyon, 1999). These traits, briefly, are characterized by the following behaviors:

- Dominance: “Getting things done”, competitiveness, leadership/taking charge, etc.
- Extroversion: People oriented, outgoing, talkative, persuasive, etc.
- Patience: Amicability, friendliness, conflict-averse, passive, etc.
- Conformity: Structured, rule-following, a need to be right, precise, careful, etc.

The assessment measures these behaviors to generate a core personality profile and then shows how that profile shifts based on work environment. These profiles are generated through four rounds of self-assessment questions where responders first rank whether they exhibit certain characteristics on a scale of 1-Strongly Disagree to 5-Strongly Agree. The second round follows a similar process, but responders must now respond in their work context. The third step involves 25 statements relating to interpersonal behavior that the responder answers true or false. Finally, responders answer a series of 17 statements relating to personal drive and motivation by ranking them 1-Disagree Strongly to 7-Agree Strongly. A sample personality profile from a university faculty member can be seen in the figure below.

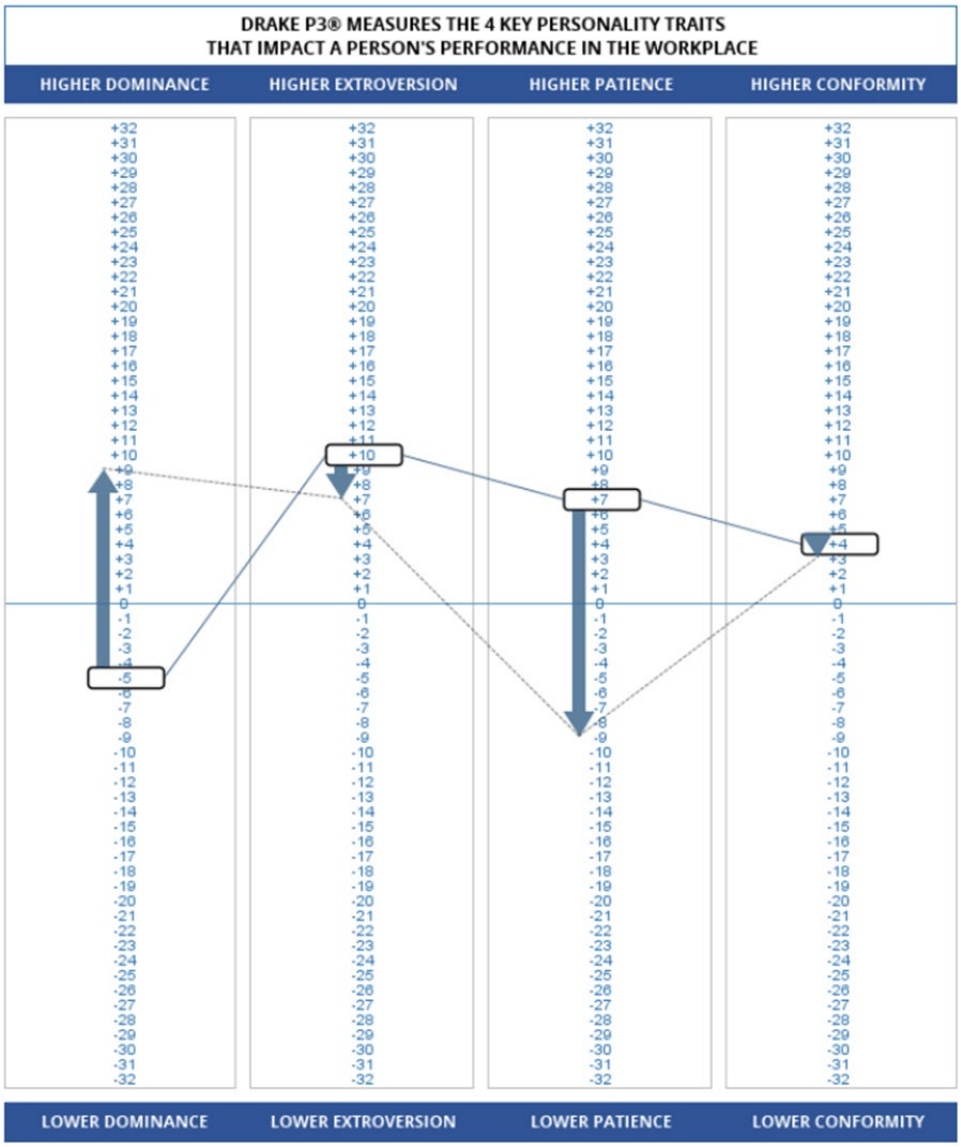

Figure 1: A Sample Drake P3© Profile for a University Faculty Member

The four columns represent the four basic traits of the assessment, with zero as a baseline and negative numbers representing lower expression of the trait and positive numbers representing higher expression of the trait. The boxed numbers highlight the faculty member's core profile, and the arrows and dotted lines show how their personality adapts to their work environment. They naturally have lower dominance and higher patience, but in their work environment at the university, they exhibit higher dominance and lower patience.

Personality profiles have been used as the groundwork for team communication, especially between people with differing profiles. However, they have not yet been fully realized as a team formation tool or resource for prediction project success. Through significant data collection and statistical analysis, the research team recognized the potential to bridge that gap. Three primary deliverables were sought: 1) An understanding of personality profiles of the study company; 2) Direct correlation between the success metric and particular personality traits; 3) An expanded correlation between the success metric and additional independent variables. The purpose of this paper is to present the personality profiles found in a company with a specific culture in place and their effects on project success. This paper highlights the opportunities of informed team selection to better project outcomes in a repeatable manner while considering other project

characteristics, such as industry, duration, billing type, and original revenue. The research framework is summarized in the figure below.

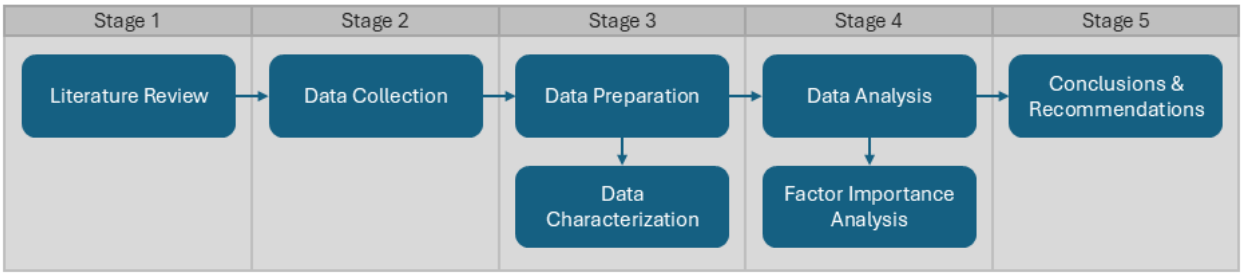

Figure 2: The Research Framework Presented in This Study

2. METHODS

The research team worked with a general contractor partner to compile labor, project, and personality profile data. As an ENR Top 100 general contractor with an annual revenue of just under 1.75 billion, the project data set had to be pared down for accurate and efficient analysis. Only projects completed between 2017 and mid 2022 with at least two full-time employees and an initial revenue of over $1 million were included in the analysis. This led to a complete data set of 202 projects, consisting of four categorical variables, two possible success variables, and six independent variables. A summary of the data set characteristics is shown in the table below.

Table 1: Data Set Characteristics for the Research Study

Categorical Variables	Project Industry *Industrial* *Healthcare* *Institutional* *Power* *Commercial*
	Project Length *Under 1 Year* *Over 1 Year*
	Project Billing Type *Lump Sum (LS)* *Time and Materials with a Guaranteed Maximum Price (T&M-GMP)* *Time and Materials (T&M)* *Guaranteed Maximum Price (GMP)*
	Project Revenue *$1-3 Million* *$3-10 Million* *Over $10 Million*
Success Variables	Profit Margin
	Change in Margin
Independent Variables	Team Environmental Scores *Dominance* *Extroversion* *Patience* *Conformity*
	Project Manager (PM) Environmental Scores *Dominance* *Extroversion* *Patience*

	Conformity
Project Coordinator (PC) Environmental Scores	
	Dominance
	Extroversion
	Patience
	Conformity
Project Engineer (PE) Environmental Scores	
	Dominance
	Extroversion
	Patience
	Conformity
Superintendent (SUP) Environmental Scores	
	Dominance
	Extroversion
	Patience
	Conformity
Project Executive (PEX) Environmental Scores	
	Dominance
	Extroversion
	Patience
	Conformity

Environmental personality traits were chosen as the focus for this study because they represent how the employees' personality profiles present at work. This means they will likely have a greater impact than the employees' primary personality traits on projects conducted at work.

The two potential success variables were evaluated and compared prior to final metric selection. They were determined to be highly correlated with a strong linear relationship, equally justifying their potential selection as shown in the figure below.

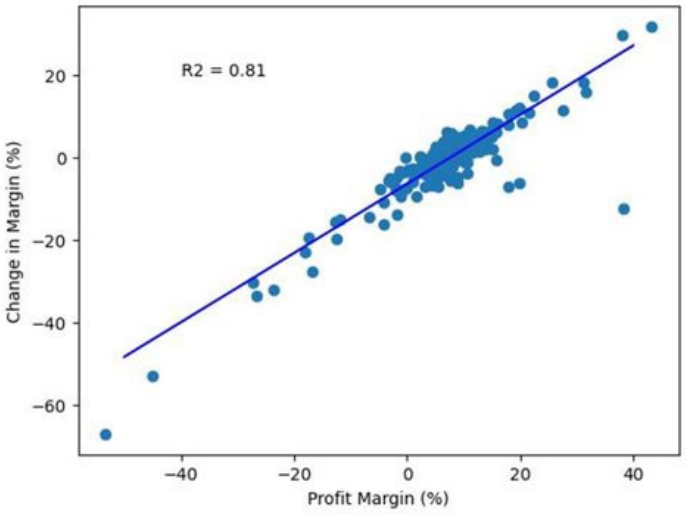

Figure 3: Graph of Change in Margin against Profit Margin Showing Linearity and Correlation

Ultimately, the researchers decided on change in margin (CIM) as the success variable because it is independent of the individual characteristics of the project and more reflective of effort while executing than other performance metrics and is thus perhaps a better representation of a team's cohesion and success. CIM is calculated by subtracting the initial (or planned) profit margin from the final profit margin. Using CIM in this analysis allows for more ready comparisons between projects that may be on the surface quite different – as all that is examined is the difference between the plan and what the team was able to achieve.

With the data set generated and success variable chosen, the research team had to gain an understanding of the company's culture. This was an important baseline for the types of employees attracted to the company partner and factored into the analysis of the personality profiles. The company partner, by happenstance, has a very structured corporate culture that values collaboration and patience, and has many systems in place for project success. In a way, we must not forget that culture shapes people as much as people shape culture in turn. By recognizing the company's culture, the research team could formulate conclusions around a particular corporate structure that may not align with every company but addresses commonalities that extend beyond cultural differences.

3. RESULTS

Following data collection, the research team generated a summary of employee core personality traits and environmental personality traits. These profiles give further insight into the company partner's culture and can be used by other companies for comparison against their own results. An aggregate of the company-wide results for employees are presented in the figure below.

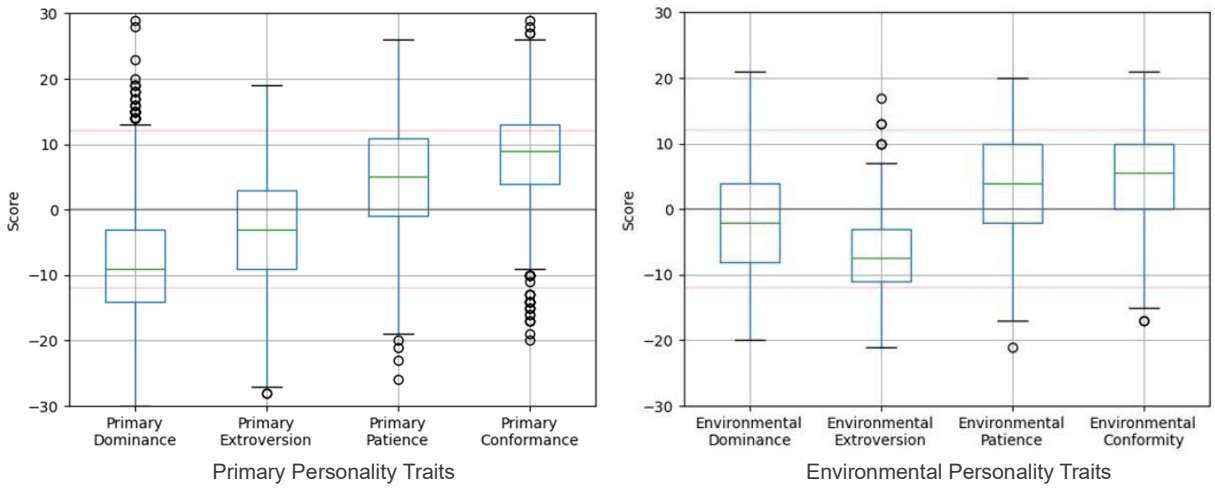

Figure 4: Drake P3© Primary Trait Distribution and Environmental Trait Distribution for All Employees in the Study Company

Company-wide, employees tend to show low dominance and high conformity in their primary profiles. This aligns with the company's structured culture and focuses on collaboration and patience. With strong systems in place, employees tend to follow the company structure and do not feel a need to push the status quo since their current system is successful. This is not to say that all employees follow this personality profile, just that these are the trends across the company. These results also do not factor in employee roles, which can lead to different high and low personality traits. Within this data set, Project Managers and Project Engineers tended to follow the company-wide personality trait distribution of lower dominance and extroversion and higher patience and conformity. In comparison, Project Coordinators showed particularly low dominance and Superintendents and Project Executives showed especially high dominance, as shown in the figure below.

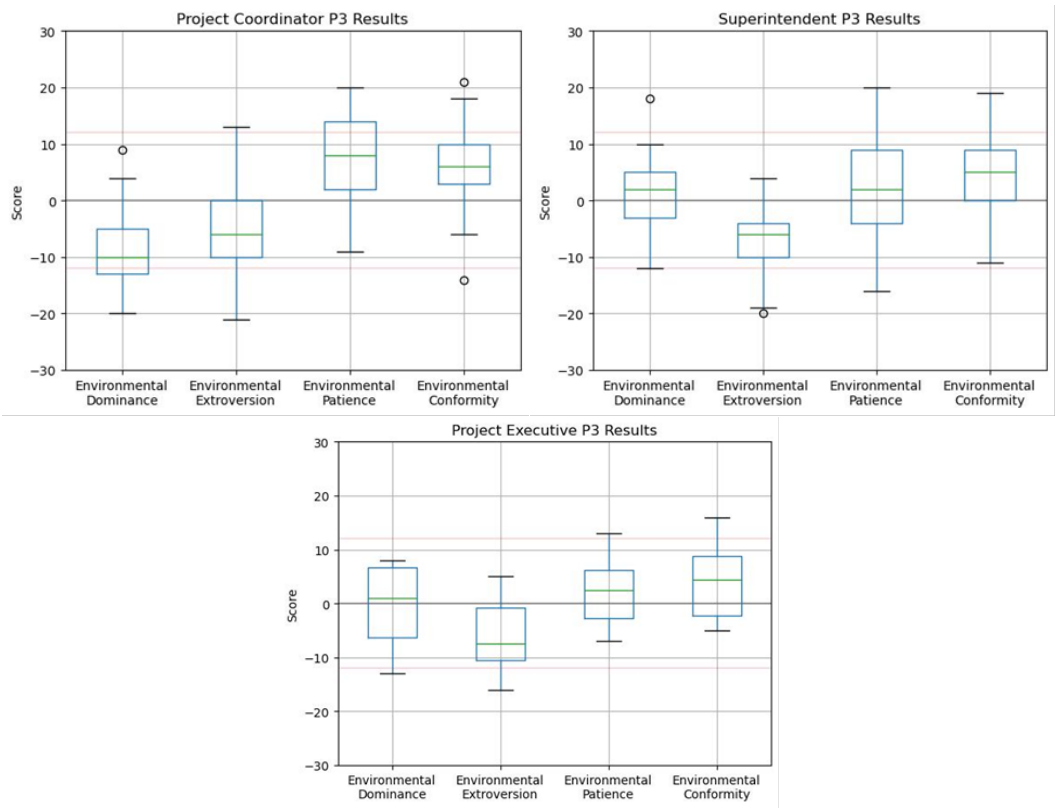

Figure 5: Drake P3© Environmental Trait Distribution Employees in Various Roles at the Study Company

These results show that there are differing personality profiles across the company that can play into project success, measured by the CIM. R was utilized for statistical analysis through mean hypothesis testing and GUIDE analysis, which generates regression trees to split data based on predefined variables. Using these methods in conjunction allowed for more inferences on factor importance. Through this analysis, the research team found a correlation to particular personality traits and their impact on a project's CIM. The results are summarized in the table below. Independent variables that showed no correlation to the CIM were excluded from the table.

Table 2: The Research Findings for Each Independent Variable that had Significant Evidence of Impacting the CIM

Independent Variable	Findings
Team Environmental Scores	Moderate evidence that lower Dominance led to higher CIMs Moderate evidence that higher Patience led to higher CIMs Moderate evidence that higher Conformity led to higher CIMs
PM Environmental Scores	Weak evidence that lower Dominance led to higher CIMs Weak evidence that lower Patience led to higher CIMs
PE Environmental Scores	Moderate evidence that lower Dominance led to higher CIMs
PC Environmental Scores	Moderate evidence that higher Extroversion led to higher CIMs
SUP Environmental Scores	Moderate evidence that lower Dominance led to higher CIMs Moderate evidence that lower Extroversion led to higher CIMs Weak evidence that lower Conformity led to higher CIMs

PEX Environmental Scores	Strong evidence that lower Dominance led to higher CIMs Weak evidence that lower Extroversion led to higher CIMs Strong evidence that higher Patience led to higher CIMs Moderate evidence that lower Conformity led to higher CIMs

The analysis also led to conclusions regarding the categorical variables impact on CIM. These results are presented in the table below.

Table 3: Research Findings Regarding Categorical Variable Impacts on CIM

Categorical Variable	Findings
Project Industry	Commercial and Industrial projects appeared to perform the best, followed by Healthcare. Projects in the Institutional and Power industries had negative CIMs on average.
Project Length	Projects with a length less 376 days tended to have a positive CIM on average, whereas projects with a length greater than 376 days had negative CIMs on average.
Project Billing Type	GMP and T&M contracts had the highest CIMs, while LS and T&M-GMP had negative CIMs on average.
Project Revenue	Projects under $1.3 million had the highest CIMs; projects between $1.3 million and $3.7 million had CIMs near zero; project over $3.7 million had negative CIMs on average.

4. DISCUSSION

The results of this analysis show that the project team does have some effect on the construction project success. Similar trends were seen in the full team and individual role data of lower Dominance, higher Patience, and higher Conformity leading to higher CIMs. Although these traits appear to make up just a small part of what is likely a much larger set of variables, small incremental increases and progress in the field will add up.

From the Drake P3© trait characterization, we know that higher patience individuals tend to be more people-focused, prioritize collaboration, and tend to approach problem-solving in a positive and optimistic way. On construction project teams, this equates to proactive risk management, collaborative problem solving, and a solution focus – which anyone might agree trend toward a more successful project.

Higher conformity, similarly, has a tendency to equate with processes, rules, systems, and high degrees of detail-orientation. A focus on quality of work is also a trait of high conformity. Again, this is perhaps logical, as all construction projects seek to output high quality work, and more individuals of this type support that outcome.

What is perhaps less obvious is the correlation between low dominance and higher project outcomes. Many individuals in construction might self-characterize as high dominance. However, consider what the Drake P3© profile tells us about dominance. Lower dominance traits include a tendency toward caution, the tendency to seek group input and consensus when decision making, and an even temperament. Whereas high dominance individuals can be intimidating, perceived as aggressive, and prioritize quick decision making even when it results in more risk-taking. For a company of the type examined here, strong structural support and systemic decision making align with the low dominance traits, which explains the increased performance of this trait on the examined projects.

It is important to understand that personality profiles are a useful tool but should be considered within the context of the company as a whole. A company that is more individualistic and agile than the structured and

team-driven one examined here might achieve higher CIM with very high dominance project teams, for example. Prior to applying any outcome of personality profiling to project data, work to understand what culture and methods are already in place at the company – as simply collecting the data will not change that culture. Once a sense of the dynamics already in play is achieved, then decisions can be made about leverage areas for improvement.

These personality profiles can be generated from a multitude of commercially available products or tailored internally by a company. The research team focused on one such product for analysis because it was compulsory for the partner company's employees. This paper should not be misunderstood as an endorsement of a particular tool because other personality assessments can be utilized to successfully gain that understanding of current company dynamics. It should also be noted that the tool in this study requires self-assessment and was not validated through a qualitative approach such as peer interviews due to project scope and the desire for a repeatable process for team selection. This limitation removes additional characteristics such as communication and internal team perception that may offer further insights into team dynamics. Future studies that consider qualitative data would expand and help validate the results of this study.
The results of this analysis show an understanding of personality traits present on a project team can be correlated project success; however, teams can only be made up of the people that are available at the time, and free selection of "perfect" teams may not be appropriate or possible. While outside the scope of this research, the research team suggests that team formation consider multiple factors, including personality dynamics, schedule availability, and additional team needs to create a project team that maximizes the utilization of each employee, as well as the success of all the teams being scheduled.

5. CONCLUSION

It was in 1917 that Cyrus McCormick coined the now oft-cited proverb: if you want to go fast, go alone; if you want to go far, go together - a maxim which is as true today as it was then. With declining construction productivity and an aging workforce in need of new hires, it is evidently critical that project teams be correctly selected given their impact on project success. The formation of a project team is one of the earliest and most critical actions that must be taken in the commencement of a project, and too often is left simply to selecting from the personnel that are available. If companies contemplating or embarking upon a new venture were able to leverage the personality traits of their staff to create teams that meet a holistic set of criteria – whose skills complement each other – it is possible to realize even greater project success.

The research team set out to investigate how personality assessments can inform team selection and contribute to greater project success. The objective of this paper is to present the correlation between personality traits and project CIMs for a particularly structured company and provide insight into additional categorical variables that can influence project success. This study included six independent variables: 1) Team Environmental Scores; 2) Project Manager (PM) Environmental Scores; 3) Project Engineer (PE) Environmental Scores; 4) Project Coordinator (PC) Environmental Scores; 5) Superintendent (SUP) Environmental Scores; and 6) Project Executive (PEX) Environmental Scores. In addition, four categorical variables were included in the study: 1) Project Industry; 2) Project Length; 3) Project Duration; and 4) Project Billing Type. This paper also presents the research results completed by the team for those who wish to review them, though an understanding of the statistical and mathematical analysis performed is not necessary to understand the process presented in this paper.

The goal of this paper is to emphasize that understanding company culture and employee dynamics is necessary to facilitate informed team selection. One way to understand the structure of a company and its employees is through personality assessments, as shown in this paper. Personality assessments provide a metric with which to compare teams and correlate particular traits to project outcomes. However, to be an effective indicator of team dynamics, personality assessments must be widespread throughout a company.

When personality profiles are widespread within a company, team dynamics can be correlated to project success through a chosen performance metric. This paper analyzed project success through change in

margin (CIM) because it is more reflective of execution effort than other performance metrics while remaining independent of individual project characteristics. Using the CIM as the success metric allows for a comparison between the plan and what the project team was able to accomplish, perhaps making it a better representation of team-related success.

This study focused on a company with structured systems in place that encouraged patience and collaboration. This could be seen in the high conformity and patience and low dominance typical of their employees' Drake P3© profiles. These characteristics were shown to lead to higher CIMs on average. Additional considerations that go beyond team selection and perhaps speak more to project selection, can also lead to higher or lower CIMs. This study found that smaller projects, in terms of revenue and length, produce higher CIMs on average with Commercial and Industrial Guaranteed Maximum Price (GMP) contracts also producing higher CIMs on average than other project industries and billing types.

The results of this analysis show that the project team does have some effect on the construction project success, but it is important to recognize that these traits appear to make up just a small part of what is likely a much larger set of variables. This research is not intended to say only individuals with particular personality traits will find success in the construction industry; on the contrary, with differing company cultures and collaboration styles, opportunities abound for varied team formation and structure. The intent of this research is to emphasize the need to understand a team if one is to replicate or change project results. If project success is not correlated to measurable team characteristics, informed team selection will not be possible, even when availability and schedules align.

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