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DEFINING EFFORT FOR COLLABORATIVE PROJECT SUCCESS

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Abstract: Collaborative contracts, such as those used for Integrated Project Delivery, create an expectation of high effort by all project team members. These contracts typically incentivize effort, but a unified definition and understanding of effort is not well understood. Project participants of two collaborative projects were surveyed, and results reveal varied definitions of and, thus, varied expectations of effort from survey respondents. Limited research exists regarding the economic quantification of such subjective factors across project-based activities, and, specifically, there is a gap in research surrounding the quantification of the role that effort plays in project-based work in the construction industry. The objective of this research is to introduce and begin to address a quantifiable and measurable definition of effort for use in collaborative construction projects.

1 INTRODUCTION

Construction contracts are evolving in step with the rise of more collaborative delivery models, such as Design-Build (DB) and Integrated Project Delivery (IPD). Contracts utilized for these delivery methods either explicitly (e.g., DB) or implicitly (e.g., IPD) encourage collaborative behaviours that assist in aligning individual goals to the goals of the project itself (Franz & Leicht, 2012). These goals are often contractually stipulated and can include financial risk and goal incentives (Raisbeck, Millie, & Maher, 2010). The collaboration that is needed, and more specifically the collaboration required by IPD projects, creates an expectation of involvement by all project team members due to the distribution of risk amongst project participants (Bilbo et al., 2015).

The collaboration required when risk is disseminated necessitates a heightened level of effort from all parties, and, because of this, can create friction between contracted entities as to the reciprocated level of effort. Daniel Kahneman (2011) noted this by saying:

A general “law of least effort” applies to cognitive as well as physical exertion. The law asserts that if there are several ways of achieving the same goal, people will eventually gravitate to the least demanding course of action. In the economy of action, effort is a cost, and the acquisition of skill is driven by the balance of benefits and costs. Laziness is built deep into our nature. (p.35)

Effort, though a cost, plays a key role in the success of a construction project. While simple to state, the definition and measure of effort can vary based on context used and/or an individual’s unique paradigm. In

a traditional principal-agent contract scenario, effort is noted as the difference between the stipulated contract and expected profit (Mcfree & Mcmillan, 1986). In production, and particularly in production of unique products, however, quantification of expected profit, may extend beyond material and labor, to items that are more subjective such as an individuals' ability, experience, and other characteristics that are known to assist in a finished product. In general, limited research exists regarding the economic quantification of such subjective factors across project-based activities, and, specifically, there is a gap in research surrounding the quantification of the role that effort plays in project-based work related to construction of unique artifacts (e.g. buildings). The objective of this research, therefore, is to introduce and begin to address the following research questions:

Is the definition of effort in the construction industry distinct from other disciplines, and/or how can it be informed by other disciplines?

Is the measure of effort in the construction industry distinct from other disciplines, and/or how can it be informed by other disciplines?

2 LITERATURE REVIEW

Limited research exists within the field of construction related to the definition of effort, specifically as related to productivity, quality and profitability. Therefore, it is useful to review, in addition to the fields of engineering and construction, as well as the fields of education, economics, psychology and neuroscience, and exercise/sports science to provide a conceptual foundation for this research area.

2.1 Engineering and Construction

When exploring the role of effort in pre-project planning, Hamilton and Gibson (1996) suggested effort is the amount of a task completed, a productivity based measurement. Likewise, Han, Lee, and Peña-Mora (2012) identified "non-value-adding effort", and assumed that effort was a unit based activity (labor-hour, labor-day, etc). Hanna and Skiffington (2010) implied effort as the totality of pre-construction planning tasks, and not necessarily a labor based metric. A similar study on construction planning completed by Shapira and Laufer (1993) used total labor-hours of various tasks to define effort. Lu et al. (2015, p.2) also used labor to define effort when looking at time-effort curves, and specifically noted effort to be ". . . the amount of chargeable service time rendered by individual participants." In short, the definition of effort in engineering and construction literature focuses on unit based measurement either related to or independent of labor.

2.2 Education

The field of education recognizes aspects of effort beyond a unit based measurement. For example, Brookhart (1997) published a framework of assessing student's effort, and noted that a student's involvement, engagement, and active interest are characteristics of effort. Schunk (1991) in reviewing self-efficacy and motivation, commented that motivation and drive towards goals are aspects that influence effort. Beliefs and Bong's (2004) research correlated effort to the length of time to mastery of a subject or success in it. Though some of these characteristics would be challenging to measure, the expanded characteristics of "effort" does allow for a broader application in IPD team settings by encouraging behaviours and involvement previously noted by Bilbo et al.

2.3 Economics

Economics also provides an expanded definition of "effort" over a unit based definition. For instance, Charness et al. (2018, p.75) gave the following definition ". . . effort could be physical, as in folding pieces of paper and stuffing envelopes, cognitive, as in solving a series of math equations, or creative, as in writing stories or packing quarters". This definition offers multiple dimensions of "effort", and suggests there are limitations to a unit based definition. Leibenstein (1982) supported additional dimensions and a element of subjectivity with regard to effort by writing the following concerning "effort" of employees or

contracted parties:

Employment contracts are incomplete since remuneration is usually well specified but effort is not. Agents (employees), in principal-agent relations, need not behave exactly as the principal's wish. As a consequence, some effort discretion exists. Hence, firm members can choose, within bounds, the amount of effort they put forth. The productivity outcome depends in part on effort choices made by firm members, and in part on the wage and work condition choices made by the firm. (p. 92)

Leibenstein went on to explain the choices used for effort by employees in a relevant scenario ". . . employees consider the average effort level in terms of pace, quality, and choice of activities . . ." (p.93). Engellandt and Riphahn (2005, p.284) in comparing the effort of temporary versus permanent employees defined effort ". . . as measured by the number of unpaid hours of overtime work . . .". Dutcher et al. (2015, p.4) acknowledge the complexity of comparing effort in a laboratory experiment to that in a non-laboratory environment by stating ". . . an alternative argument is that real effort tasks, by their nature of involving actual mental or physical exertion, are able to trigger certain types of behavior that a stylized design would not be able to".

2.4 Psychology

The field of psychology offers additional insight into the motivation of effort within individuals and/or teams. Kurzban (2016) studied motivation behind exerting effort, and concluded that exerting effort is often associated with unpleasant tasks. He went on to explain the cost-benefit of the reward as being motivation of the effort. Kurzban also stated that ". . . people's decisions to engage in these aversive activities depends on external rewards, and that people balance the benefits of the rewards for persisting in effortful tasks against the cost of continuing" (p.64). Sandra and Otto (2018) found that incentives can offset the cost of "cognitive processing resources", or involvement and engagement. This perception of effort was studied by Krugar et al. (2004), and they proposed that time spent on a task, and/or the ease of accomplishing a task is an indicator of effort spent – with the effort spent being an indicator of quality. Inzlicht et al. (2018, p.338) defined effort as the ". . . intensification of either mental or physical activity in the service of meeting some goal. Related to, but distinct from, demand or difficulty . . ." In sum, psychology literature explores effort as being distinct from productivity.

2.5 Exercise/Sports Science

Exercise/Sports science offers a different view. In sports, physical aptitude can be measured, but team dynamics can also shape the implementation of an athlete's ability. Sarrazin et al. (2002) defined effort as the ". . . maximal level of energy resources provided . . .", and measured productivity as a unit measurement. Weimar and Wicker (2017) studied soccer matches and used two measures for effort, total running distance of a player and number of intensive runs per play per game by players. These measures had a strong correlation to a team's performance, suggesting a relationship between individual effort and team performance. Pageaux (2016) commented on the need for more research on the perception of effort, but noted that a player's perception of effort has been linked to engagement and commitment. Pageaux went on to explain that perception of effort could be explained as a "cognitive feeling of work associated with voluntary actions." suggesting that effort may involve actions beyond the minimum requirement.

There was not one definition or measurement of effort in any of the field's reviewed, but the brief review of literature, in aggregate, suggests that effort is a combination of unit-based attributes in conjunction with other less measurable components like participation, engagement, and/or commitment to a goal. Table 1 presents a summary of this review. The noted ambiguity around the attributes of effort, and thus an inability to measure project participant's output based on this ambiguity, provides an opportunity for conflict and inefficiencies within a collaborative environment.

Table 1: Literature Review Summary

Literature	Year	Field	Proposed Measure of Effort
Charness et al.	2018	Economics	Unit based, behavior, and/or cognitive
Leibenstein	1982	Economics	Unit based, behavior, and/or cognitive
Detcher et al.	2015	Economics	Unit based, behavior, and/or cognitive
Hamilton and Gibson	1996	Engineering and Construction	Unit based activity (labor-hour, total hours, completion quantity)
Han, Lee, and Pena-Mora	2012	Engineering and Construction	Unit based activity (labor-hour, total hours, completion quantity)
Hanna, Skiffington	2010	Engineering and Construction	Unit based activity (labor-hour, total hours, completion quantity)
Shapira, Laufer	1993	Engineering and Construction	Unit based activity (labor-hour, total hours, completion quantity)
Lu et al.	2015	Engineering and Construction	Unit based activity (labor-hour, total hours, completion quantity)
Beliefs and Bong	2004	Education	Unit based activity (labor-hour, total hours, completion quantity)
Krugar et al.	2004	Psychology	Unit based activity (labor-hour, total hours, completion quantity)
Sarrazin et al.	2002	Exercise/Sports Science	Unit based activity (labor-hour, total hours, completion quantity)
Weimar and Wicker	2017	Exercise/Sports Science	Unit based activity (labor-hour, total hours, completion quantity)
Engellandt & Riphahn	2005	Economics	Unit based activity (labor-hour, total hours, completion quantity)
Kurzban	2016	Psychology	Motivation of Effort
Schunk	1991	Psychology	Motivation of Effort
Sandra and Otto	2018	Psychology	Motivation of Effort
Brookhart	1997	Education	Behavioral, involvement, engagement
Schunk	1991	Education	Behavioral, involvement, engagement
Inzicht et al.	2018	Psychology	Behavioral, involvement, engagement
Pageaux	2016	Exercise/Sports Science	Behavioral, involvement, engagement

In sum, results of this preliminary, multi-disciplinary literature review demonstrate that consensus does not exist around a definition or measure of “effort.” As such, additional study within and beyond the field of construction is merited. The following section summarizes a few findings from a related survey administered by the authors to members of project teams working to construct two complex healthcare facilities. The objective of the survey was to understand the effects, if any, of two differing construction contracting vehicles had on effort.

3 EFFORT’S AFFECT WITHIN CONSTRUCTION

As previously noted, the definition of “effort”, can vary. Consequently, monitoring the effectiveness of incentives to increase effort is difficult. For this research, a survey was sent to 26 representative project members of two similar IPD projects located in Colorado’s Denver metro region. 17 responded (65% response rate). Survey questions utilized a five point Likert Scale with additional space for comment. Survey questions were intended to solicit feedback regarding individual participation, resource allocation, and magnitude of allocated risk across designers and contractors working under IPD contracts.

Respondents were asked the following questions, and their responses can be seen in figure 1:

- 1) Did the contract/project type require additional effort?
- 2) Did the contract/project type require additional labor?
- 3) Did the contract/project type affect productivity?

Note that no formal definition of effort was provided in the survey.

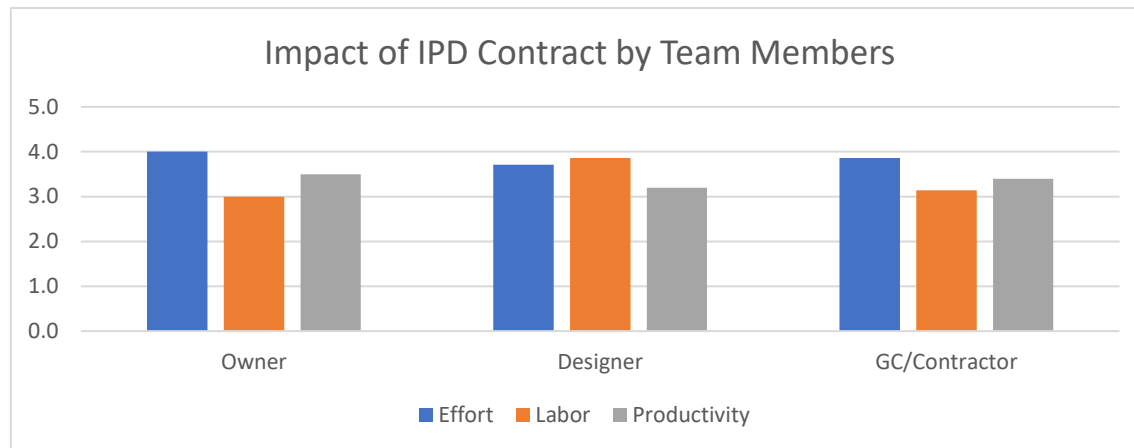


Figure 1: Impact of IPD Contract of level of Effort, Labor and Productivity Required

Figure 1 demonstrates that representative groups noted a difference in how the contract affected effort, labor, and productivity (1 = no impact; 5 = significant impact). While differences across professions are notable, more notable is the fact that levels for effort, labor and productivity vary across all groups. Logically, if these concepts were perceived as similar, results would not vary. Instead, a variation can be seen both across groups and within groups. For example, designers had the least variation when comparing effort to labor and productivity; they also had median levels for all three compared to owners and GCs. In contrast, Owners had the highest variation with the lowest estimate of labor but highest for both effort and productivity. While results from this survey may or may not be generalizable, they are informative and suggest that differences exist between both definition and perceived levels of effort, labor, and productivity across professional associated with the construction industry.

4 DISCUSSION OF EFFORT

A collegiate basketball coach (D. Jablonski, personal communication, February 20, 2019), stated that a player's effort could be monitored. However, he defined effort as not being associated with a player's athletic ability, but rather with determination, energy on the court, and sacrifice. These factors could be tracked by the coaching staff during games, and shown to players during breaks to assist in motivation towards the team goal. Likewise, a middle-school principal (J. Sanders, personal communication, February 23, 2019) noted that eliciting effort in students was not something that they measured, but instead monitored with each classroom teacher and rated by each student. In another case, a former US Navy Construction Battalion officer (T. Doyle, personal communication, February 22, 2019) noted that in his experience, effort was known to be a combination of productivity and ability. Eliciting greater effort needed to be tailored to the individual, but that effort was tracked more by the unit as a whole and not specifically by the team leadership.

These examples illustrate various models for effort. Furthermore, if effort were a combination of productivity and some aspect of behaviour, then expending resources in the promotion of the two sides of effort would assist in a collaborative project environment.

While monitoring productivity is common in many industries, measuring behavior is not common in the construction industry. However, as the commercial construction industry transitions to more risk-sharing collaborative contract and project delivery types, it is becoming more important to measure and motivate effort. Inzlicht et al. (2018, p.338) spoke to this "Although related, effort is not the same as motivation, which is a force that drives behavior by determining both a direction (e.g. goal) and the intensity or vigor with which the direction is pursued. Effort refers to the intensity or amplitude of behavior, but does not refer to any specific goal."

Measuring effort ought to start during the onboarding process to encourage project participants to maximize effort. Sandra and Otto (2017) used a questionnaire to evaluate and measure the extent in which individuals engage and enjoy demanding activities, with questions like: “I prefer complex to simple” and “I prefer my life to be filled with puzzles I must solve”. While such questions may seemingly have limited relevance to a project’s success, they may assist in finding individuals willing to engage in the IPD process and the benefits that result from collaboration.

Finally, as a person’s ability increases their perception of effort changes. This change in the sense of effort can result in a tension between individual and group effort (Brookhart, 1997). To this point, Kruger et al. (2004) wrote about Jackson Pollock’s “drip method” paintings and what little respect his artwork received from critics initially due his seemingly random and simple method. Though his art looked simple, his method was an exhausting process that often-required weeks or months of work to complete. This example illustrates the potential for subjectivity when assessing effort; especially in a team setting where the risk of team member “free riding” on the work of others is a concern. This is important because as the construction industry moves to more collaborative team-centered contracting vehicles, it is imperative to understand, encourage, and evaluate the necessary level of effort to achieve project goals.

5 CONCLUSION AND FUTURE WORK

This research provides insight into the definition and measure of effort to assist with project outcomes on collaborative projects. The literature reviewed highlights current ambiguity surrounding the definition of effort. Defining effort, however, is critical to the success of collaborative projects, and serves as the basis of contractual incentives. Of the literature reviewed, half noted effort as a unit-based function, while half noted effort as some aspect of behavior or personnel motivation. Coalescing this definition to track and improve a team’s performance is important to the success of collaborative projects that incentivize effort, such as Integrated Project Delivery.

An online survey was used to collect information from twenty-six project participants of two similar projects. Results highlight the that project participants acknowledge difference in effort from labor and productivity. While results from the survey may or may not be generalizable, it is informative and suggest that effort is distinct from labor and productivity within construction.

Future research opportunities include 1) generate precise definition of effort which incorporates associated behaviors in construction 2) create guidance as to how to promote high effort situations with successful project outcomes 3) create a method for evaluation of project effort by participants.

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