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IDENTIFYING FACTORS AFFECTING MOTIVATION OF CONSTRUCTION CREW WORKERS

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Abstract: Motivation is a critical factor affecting construction crew performance. Motivation arises from various internal and external factors such as self-efficacy, assigned goals, and other sources. On construction and industrial projects, workers usually work in crews; thus, performance factors such as productivity are mostly measurable at the crew level. Crew motivation is one factor impacting crew performance. However, it is difficult to define and measure crew motivation in construction, due to the uniqueness and dynamism of the construction environment. Additionally, motivational factors may be described in the form of subjective or objective data. Therefore, a method of measurement is required to systematically and explicitly measure each factor affecting crew motivation and therefore performance. This paper reviews theories and models of motivation that have been developed in research domains other than construction. Next, it overviews motivation literature within the construction domain, and discusses shortcomings of these current approaches. From the literature review, the key factors affecting crew motivation are identified. Finally, the paper proposes a method of measuring crew motivation. The findings and methods presented in this paper will help to define and measure construction crew motivation which will contribute to better predictions of performance.

1 INTRODUCTION AND PROBLEM STATEMENT

There are different definitions of the term “motivation” in existing literature. Colquitt et al. (2013) trace the word to its Latin roots: “motivation” derives from the Latin word for movement, *movere*. Motivated people usually move or work faster and for longer periods of time than unmotivated people, which makes this Latin root particularly representative of the concept of motivation (Colquitt et al. 2013). Based on Latham and Pinder’s (2005) definition, for an employee, motivation is a set of internal and external energetic forces. Motivation triggers the effort to perform a task. Motivation also determines the three characteristics of such effort: direction, intensity, and persistence (Latham and Pinder 2005). Campbell (1970) defined motivation as “the extent to which persistent effort is directed toward a goal”.

Motivation is a critical factor affecting construction crew performance. An effective job performance often requires high levels of both ability and motivation; therefore, motivation is a critical consideration (Maier 1955). However, there is a lack of research on factors affecting motivation in the construction area. Motivation is a major area of research in domains other than construction. Much research has been done in business, management, psychology, industrial psychology, and organizational behavior. In this paper, research in these domains is reviewed. There are some gaps and shortcomings in the research done on motivation; most theories of motivation consider motivation on an individual level. Some theories, like equity theory, recognize that the individual may compare himself or herself to others (e.g., to another group member or another company personnel). As workers mostly work in crews on construction sites, there is a need to evaluate the motivation of workers at the crew level.

Research on motivation in the construction domain suffers from many gaps and shortcomings. The objective of this paper is to define a method to measure crew motivation based on factors that have been derived from literature in both non-construction and construction domains. This paper is organized as follows: First, a comprehensive review of past research is presented on theories of motivation in general domains (e.g. general management, social psychology, applied psychology, personnel psychology, occupational and organizational psychology, and organizational behavior). Secondly, the paper provides a review of motivation literature specifically in the construction domain. Factors that affect construction crew motivation are identified from the reviewed literature. A model of crew motivation is then proposed based on the factors that have been derived from the literature in both non-construction and construction domains. Lastly, a method is proposed to measure the factors affecting construction crew motivation and to measure the overall crew motivation. The findings of this paper will help to define and measure construction crew motivation, which will contribute to better prediction and management of construction labour productivity and project performance. The findings of this paper also provide a basis for future research on construction crew motivation.

2 REVIEW OF MOTIVATION THEORIES IN NON-CONSTRUCTION DOMAINS

Theories of work motivation can be categorized broadly into two groups: (1) content (need) theories of work motivation and (2) process theories of work motivation. Content theories focus on human needs as the main source of motivation and specify the types of needs people have. Psychologists have spent several decades studying types of human needs and have proposed different need structures. Three prominent need theories of motivation are Maslow's hierarchy of needs, Alderfer's ERG theory, and McClelland's need theory. Process theories provide information about how motivation occurs by presenting the factors that affect the motivation and describing the causal relationship between such factors and motivation. Process theories and need theories are not contradictory but complementary (Johns and Saks 2011). However, since this paper ultimately proposes metrics for construction crew motivation and the factors that contribute to it (i.e., it focuses on causal relationships between motivational factors and motivation), it relates most directly to process theories of motivation, the most prominent of which are summarized here. In 1964, psychologist Victor Vroom introduced the first complete version of expectancy theory. Based on the expectancy theory, motivation is determined by the outcomes that people expect to occur as a result of their actions on the job (Vroom 1964). Equity theory was introduced by Adams in 1965. Unlike expectancy theory, equity theory poses that motivation does not depend only on employee beliefs about himself or herself and on personal circumstances, but also on employee beliefs about other people. Bandura (1986) defined perceived self-efficacy as "people's judgment of their capabilities to organize and execute courses of action required to attain designated type of performance". Bandura proposes that perceived self-efficacy works as the motivational force to take an action. In goal-setting theory, goals are viewed as the primary drivers of an effort (Locke 1968). Goal-setting theory suggests that assigning specific and difficult goals to employees will result in higher levels of performance compared to assigning no goals or easy goals (Locke and Latham 1990). In 1991, Ajzen proposed the theory of planned behaviour. This theory suggests that "intentions to perform behaviour of different kinds can be predicted with high accuracy from attitude toward behaviour, subjective norms, and perceived behavioral control" (Ajzen 1991). Self-determination theory (SDT) suggests that people are motivated to pursue behaviours that lead to the satisfaction of three innate psychological needs: competence, autonomy, and relatedness. According to SDT, the nature of one's motivational experience

varies along a continuum of internal versus external control (Ryan and Deci 2000). In primary models of goal setting, the focus was on the effect of an assigned goal on personal goals and also the effect of personal goals on performance (Locke 1968; Locke and Latham 1990). More recently, Mitchell et al. (2000) proposed an integrative model of the effect of goals on performance, in which self-efficacy and personal goals are determinants of performance in addition to ability and other factors. In 2001, Locke proposed an integrative model of motivation around the concept of the motivation hub. The motivation hub model consolidates two previously described models: goal-setting theory (Locke 1968; Locke and Latham 1990) and social cognitive theory (Locke 2001). Johns and Saks (2011) proposed another integrative model of motivation that considers expectancy theory (Vroom 1964), goal-setting theory, equity theory (Adams 1965), and need theories.

The above review conveys how different theories and models of motivation in the general domain have developed over time. It also shows which motivational factors have been considered by psychologists and other experts in domains other than construction. Comparing the motivation literature in the general domain to that which exists in construction will help identify the gaps in and shortcomings of motivation research in the construction domain. Thus, the next step is to review the motivation literature in construction in order to understand which motivational factors and motivation theories have not been considered in this area so that the factors affecting crew motivation can be better defined.

3 REVIEW OF MOTIVATION LITERATURE IN THE CONSTRUCTION DOMAIN

Early research on motivation in the construction domain was mostly related to the definition of motivation, with a focus on expectancy theory. Maloney (1981) reviewed studies about construction worker motivation and discovered a lack of empirical research. Soon after, use of the expectancy theory of motivation and performance was proposed in the construction area following the surveys administered to construction workers on the importance and satisfaction of various job-related factors. This research introduced three worker motivational factors: work, supervisor or leader behavior, and incentives (Maloney and McFillen 1986). Questionnaire responses and data collected from different trades were analyzed in order to determine the impact of the work crew on individual worker motivation; this analysis resulted in the conclusion that contractors must manage their work crews in terms of planning, organizing, staffing, directing, and controlling in order to increase worker performance and satisfaction (Maloney 1987). Overall, these early research efforts lacked clarity and rigour in selecting factors, used a limited number of factors, or, in some cases, demonstrated a misunderstanding of motivation theories and concepts. In the following years, researchers expanded on the identification of motivational factors in construction, although such research varied in terms of rigour and comprehensiveness. Carrier (1992) briefly introduced general motivational factors in the workplace. Khan (1993), after reviewing popular motivation theories, concluded that “each theory deals with selected aspects of human behavior that, if managed carefully, motivate people and thus improve productivity” (Khan 1993). Shoura and Singh (1999) used a questionnaire to quantitatively assess motivational parameters of engineering managers. These studies defined motivational factors very generally and based their definitions on the suggestions of previous authors without providing original data analysis. Recently, researchers investigated motivational factors relating to specific types of employees in the construction industry. For example, Cox et al. (2006) identified factors that promote positive motivational behavior in construction subcontractor crews. Šajeva (2007) summarized research done in defining knowledge workers and identifying factors affecting their motivation and loyalty. She identified five motivator categories: work, personal growth and continuous learning, autonomy and personal freedom, status and recognition, and monetary motivators. Siriwardana and Ruwanpura (2012) specified motivational factors as one category of factors affecting productivity in addition to management, supervisor’s assessment, and technical skills. However, their study includes a limited number of factors, provides no ranking between the different factor categories, and is not based on job-site data collection.

In summary, this review of motivation literature in construction shows that there are major shortcomings in this research area: studies largely relied on expectancy theory without integrating other and more recent motivation theories, lacked data analysis and therefore based recommendations only on authors’ personal perceptions, and were performed based on questionnaires with no job-site (field) data collection. Comparing the Section 3 review of motivation literature in construction with the Section 2 review of

motivation literature in general reveals many gaps in construction motivation research that should be addressed. One such gap is defining all factors affecting crew motivation in construction. These factors should be identified from developed theories and models of motivation in the general domain. While previous studies have identified some motivational factors in construction, researchers have yet to produce a comprehensive list of factors that adequately addresses all possible sources of motivation. Section 4 addresses this gap by defining a list of motivational factors affecting crew motivation.

4 IDENTIFICATION OF KEY FACTORS AFFECTING CREW MOTIVATION

In this section, factors affecting crew motivation are identified from the motivation literature in both construction and non-construction domains. To accomplish this task, two major issues must be kept in mind. One issue is that theories of motivation have developed and evolved over the last 80 years. Some theories dominated for a period of time before declining in prominence at the arrival of new theories. However, recent literature published in the last decade has tended to integrate numerous earlier theories to propose more comprehensive meta-theories of motivation that overcome the limitations of any of their component approaches alone. Another issue is that existing motivation theories are concerned with the motivation of individuals. However, in construction, individuals usually work in a crew whose performance (e.g., productivity) can only be measured as an aggregate of the individuals' performances (i.e., at the crew level). Therefore, factors affecting motivation in the construction context should also be measurable at the crew level and should include factors affecting crew motivation as a result of peer influence.

Among motivation theories, expectancy theory and self-determination theory are more related to individual motivation, while goal-setting theory and equity theory are more related to team or crew motivation. As the motivation of a worker who is working in a crew results from a combination of different factors related to both the individual and the group, it is important to consider all possible sources of motivation in developing a base model of motivation for the construction domain. For example, a worker may be motivated by goals assigned by the foreman; at the same time, the worker may be motivated by the perception that the ratio of his or her output (e.g. income) to input (e.g. time spent on tasks) compares favourably to co-workers. The recent, integrative theories of motivation (e.g., Johns and Saks 2011) are useful in accounting for these multiple, distinct, interacting motivational factors. In this paper, we group factors affecting crew motivation into five different categories: individual factors, crew factors, project factors, industry factors, and context factors. In each category, we identify factors affecting crew motivation from the motivation theories discussed in previous sections.

4.1 Individual Factors

Factors affecting crew motivation at the level of the individual are those which concern individual workers' self-efficacy and self-set goals. We use the motivation hub model (Locke 2001) to identify factors affecting crew motivation in this category. Based on the motivation hub model, self-set goals (i.e., personal goals or intentions) and self-efficacy (i.e., task-specific self-confidence) are two factors affecting motivation. Although these factors are measured at the individual level, in our model they are grouped together and evaluated at the crew level so that they can be used to assess crew performance.

4.2 Crew Factors

Factors affecting crew motivation at the level of the crew are those which concern the effects of working in a group. We use equity theory (Adams 1965) and the theory of planned behaviour (Ajzen 1991) to identify factors affecting crew motivation this category. Equity theory deals with peer influence by recognizing that employees compare themselves to other referent persons. These referent persons may be in the group, in the company, or outside. Employees compare their own work inputs and resulting outcomes to the perceived inputs and outcomes of their referent persons—their peers—and they adjust their ratio of inputs to outcomes (performance) so that it equals that which they perceive of their peers. Based on this theory, equity perception is a factor that affects worker motivation and therefore crew motivation. According to the theory of planned behaviour, attitude (personality), subjective norms (e.g., social pressures), and perceived behavioural control (perceived ability) are factors that define motivation. While working in a crew a worker may feel social pressure from other crew members. This felt social

pressure (subjective norms among crew members) affects the worker's motivation. In other words, based on the theory of planned behaviour, crew norms are another factor affecting crew motivation. To identify factors affecting motivation in this category, in addition to using theories and models of motivation, the influence of group processes (i.e., the effect of working in a group on an individual in the group) must also be considered. Our model therefore considers crew characteristics (e.g., crew size) and crew similarity (e.g., the extent to which workers' ethnicities are similar) as factors affecting crew motivation.

4.3 Project Factors

Factors affecting crew motivation at the project level are those which concern the effect of working on a project or for a company. Our model considers equity theory (Adams 1965), the theory of planned behaviour (Ajzen 1991), and self-determination theory (Ryan and Deci 2000) in identifying project factors affecting crew motivation. Based on equity theory, the equity perception of a worker in relation to other company employees is a factor that affects crew motivation. Based on the theory of planned behaviour, a worker may feel social pressure (company norms) from other company members. Therefore, company norms are another factor affecting crew motivation. Based of self-determination theory, motivation types vary according to regulatory styles (i.e., different methods of control) that exist in a company.

4.4 Industry Factors

Factors affecting crew motivation at the industry level are those which concern the effect of working in an industry sector, as a member of a labour group, or in a regional economy (e.g., as a member of a union or in a specific provincial economy). Our model considers equity theory (Adams 1965) and the theory of planned behaviour (Ajzen 1991) in identifying factors affecting crew motivation in this category.

4.5 Context Factors

Factors affecting crew motivation at the context level are those which derive from the context in which the work is being done. For example, market conditions are a context factor that may affect crew motivation. Table 1 summarizes key factors affecting crew motivation in these categories.

Table 1: Key factors affecting crew motivation

Factor Category	Key Factors
Individual	Self-set goals (goal commitment), self-efficacy
Crew	Perceived equity to other crew members, crew norms, crew characteristics, crew similarity
Project	Perceived equity to other company employees, company norms, company culture, regulatory style
Industry	Perceived equity to others outside company, industry norms
Context	Market conditions

5 PROPOSED MODEL FOR PREDICTING CREW METRICS FROM CREW MOTIVATIONAL FACTORS

Based on the identified factors affecting crew motivation, we propose a model for predicting crew metrics from crew motivational factors in Figure 1. As shown in the model, factors affecting crew motivation in the different categories (individual, crew, project, industry, and context) are organized in a hierarchical structure. These factors are defined and discussed in Section 4. In the proposed model, crew metrics include: crew overall performance, turnover, absenteeism, and safety (e.g., incidents). Crew overall performance is further divided into three categories: task performance (e.g., productivity, rework), contextual performance (i.e., organizational citizenship behaviour [OCB], either interpersonal or organizational, such as helping others or following rules), and counterproductive behaviour of an interpersonal or organizational nature (e.g., gossiping, wasting resources).

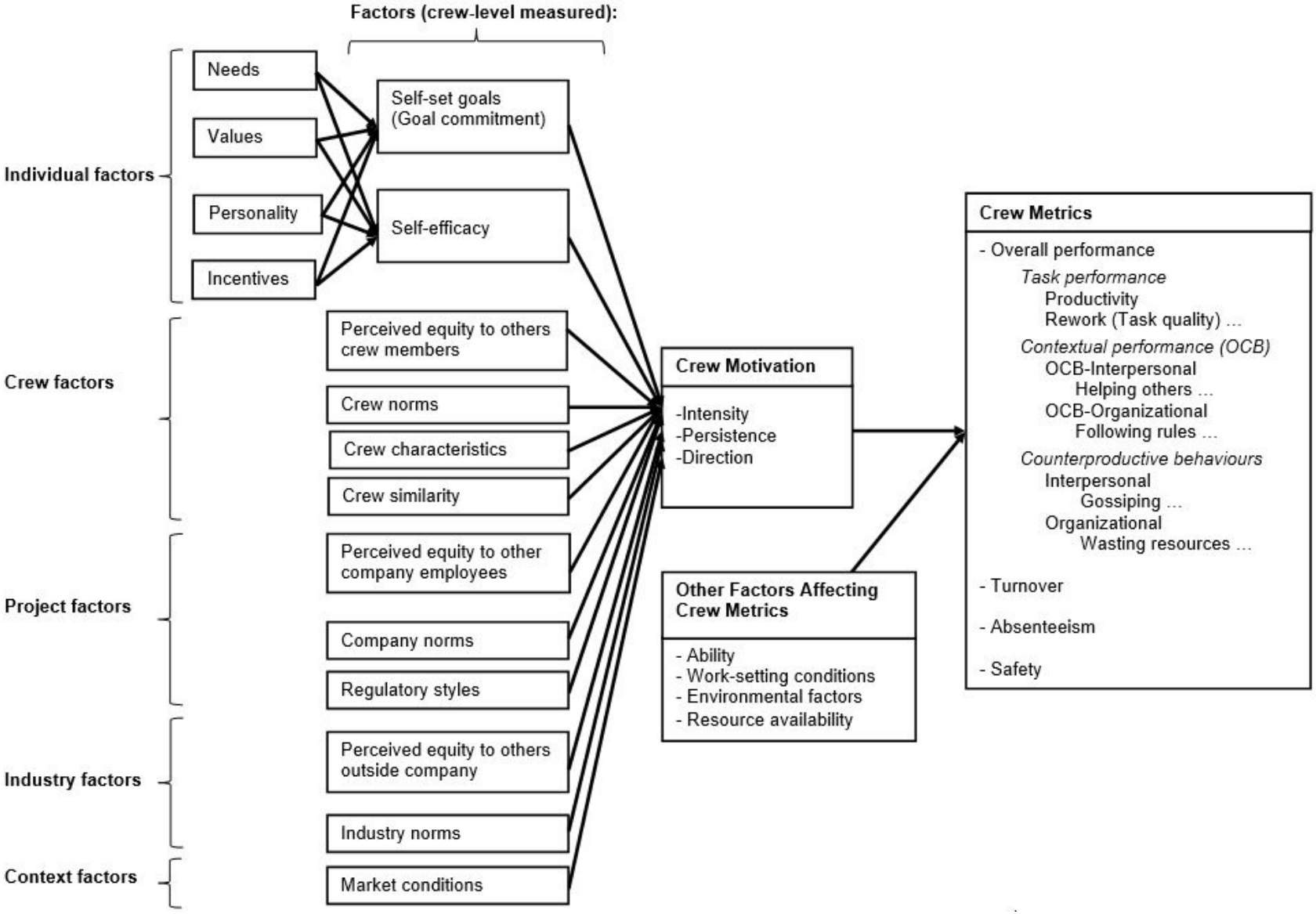

Figure 1: Model for Predicting Crew Metrics from Crew Motivational Factors

These metrics (i.e., crew overall performance, turnover, absenteeism, and crew safety) are included in the model because each is affected by crew motivation. In addition to the identified factors affecting crew motivation, the model also includes other factors affecting crew metrics: ability, work-setting conditions (e.g., factors such as distance to lunchroom, access to tools and equipment, and noise level in working area), environmental factors, and resource availability. Since performance in construction is usually measured at the crew level, motivational factors affecting crew performance should also be measurable at the crew level. Measurement of motivational factors and crew motivation are discussed in the next section. However, this paper only focuses on defining and measuring motivational factors and crew motivation; crew metrics will be defined in future research.

6 METHOD OF MEASURING MOTIVATIONAL FACTORS AND CREW MOTIVATION

This section describes how to measure both the motivational factors and the crew motivation. According to our model, the first concepts to be measured are factors affecting crew motivation. Measurement should be designed for each factor in order to appropriately quantify that factor. Factors may be in the form of quantitative data (e.g., crew size is three workers) or qualitative data (e.g., crew similarity is high). Therefore, both quantitative and qualitative types of data should be collected. The second concept to be measured is crew motivation; an overall measure for crew motivation should be defined. In the following sections we describe the measurement of these two concepts (motivational factors and crew motivation).

6.1 Identifying and Selecting Measures of Motivational Factors

Identification of measures in this research depends on the type of data that is to be collected. The data type may be quantitative (e.g., an objective attribute such as crew size or weather conditions) or qualitative (e.g., a subjective attribute such as crew similarity and company norms). As our model includes both subjective and objective variables, we need to collect both qualitative and quantitative data. Weather conditions, as an objective input variable, can be measured by objective attribute values (e.g., temperature: 28°C, humidity: 52% humidity, wind speed: 10 km/hr). Crew similarity, as a subjective input variable, can be measured by subjective terms of its attributes (e.g., high similarity in crew members' ethnicity, medium similarity in number of languages spoken in crew, very low similarity among crew members in years of experience). Subjective terms like "very low", "low", "medium", "high", and "very high" can be used as linguistic descriptors in a predetermined rating scale. The advantage of using predetermined rating scales is that they provide better definitions for factors and thus lead to more consistency in the collected data. Our model requires the collection of both subjective and objective data. However, we define and use predetermined rating scales for the subjective data. Table 2 shows an example of how measures for one factor—crew similarity—are identified and selected.

For measuring motivational factors, different types of data collection tools and techniques may be used such as company (project) databases and documents, questionnaire surveys (self-reports), interview surveys, and work sampling. Depending on the project under study, the availability and suitability of a potential source of information should be investigated. For example, factors such as company norms (e.g., having a good attitude toward colleagues is mandatory; following manager-imposed rules and disciplines is mandatory) may be available in the company or project database. However, many of the factors that affect worker motivation are based on individual perception. For example, self-efficacy is a worker's perception of his or her ability to do a job. Similarly, perceived equity to other members of the crew is a factor that relates to a worker's own perception. For these types of factors, there is a need to obtain the opinions of workers through questionnaire surveys or interview surveys. An advantage of interview surveys is that this method of data collection provides a better understanding of the research situations for the respondents and probably more accurate and useful responses as compared to self-reports. Therefore, structured interview surveys are the most suitable method for collecting motivational factors because they allow researchers to capture the advantages of both face-to-face interviews and structured survey questionnaires.

Table 2: Identification and selection of measures: Crew similarity

Key Factor	Factor Attributes	Data Type	Scale of Measure	Description
Crew similarity	Similarity in crew members' ethnicity	Qualitative	1–5 predetermined rating	1-Very diverse ethnicity 2-Diverse ethnicity 3-Somewhat diverse ethnicity 4-Similar ethnicity 5-Very similar ethnicity
	Number of languages spoken	Numerical	Number	
	Similarity among crew member experience	Qualitative	1–5 predetermined rating	1-Very diverse abilities, very diverse problem-solving techniques, very diverse backgrounds 2-Diverse abilities, diverse problem-solving techniques, diverse backgrounds 3-Somewhat similar abilities, somewhat similar problem-solving techniques, somewhat similar backgrounds 4-Similar abilities, similar problem-solving techniques Similar background 5-Very similar abilities, very similar problem-solving techniques, very similar backgrounds

6.2 Measurement of Crew Motivation

Once the factors affecting crew motivation have been measured, the overall motivation level of the crew must be measured so that it can be related to the factors affecting crew motivation for model development (as shown in Figure 1). When attempting to measure crew motivation, experts often find it difficult to express a score using exact numbers because of inherent uncertainty. For this reason, the use of linguistic terms makes expert judgments more reliable and informative, which is why we have chosen to express crew motivation scores in this way. The first step in measuring overall crew motivation is to define evaluation criteria for crew motivation. As mentioned in Section 1, motivation is concerned with the intensity, persistence, and direction of effort (Johns and Saks 2011). Accordingly, in our model, these three attributes are evaluated and measured on a rating scale in order to define crew motivation. The second step is to measure crew motivation based on the defined measurement criteria. The available sources of this measurement data are the crew workers themselves, the foreman, and direct supervisors. It is possible to ask the workers, foreman, and supervisor about the crew motivation in form of a survey; however, this method poses some challenges for aggregating the respondents' opinions. As some of the crew metrics attributes (e.g., crew productivity) are measureable only at the crew level, it is important that in these cases the relevant measurement is also taken at the crew level. In other words, all motivation attributes should be measured for the crew as a whole (e.g., How intense is the effort of crew workers? How persistent is the effort of crew workers? To what extent did the crew direct their effort toward their tasks?). The challenge here is related to aggregation of different expert opinions about crew motivation.

The aggregation of individual judgments into a group opinion requires a measured level of consensus. Omar and Robinson (2014) proposed a framework for measuring competencies for construction projects. In their work they used OWA (Ordered Weighted Averaging) to aggregate different expert opinions. Ben-Arieh and Chen (2006) introduced a new linguistic-labels aggregation operation for handling an autocratic group decision-making process under linguistic assessments. They proposed a FLOWA (Fuzzy Linguistic OWA) algorithm. The methodology they presented has two outcomes: a group-based recommendation and a score for each expert reflecting the expert's contribution towards the group recommendation (Ben-Arieh and Chen 2006). Both methods (OWA and FLOWA) can be implemented here to define a score for

crew motivation. The difference is that OWA provides a point score as representative of each expert judgment of crew motivation while FLOWA provides a fuzzy set for each expert judgment of crew motivation. After implementing either OWA or FLOWA, all scores experts assigned for various crew motivation attributes are aggregated to define the crew's motivation. Ben-Arieh and Chen (2006) considered applying the classic aggregation method, in which each expert's importance is multiplied by their expert opinion score. Following this method, a crew motivation score is defined including a combination of different opinions of crew motivation.

Measuring crew motivation and the factors affecting it will help in modeling and identifying the most critical factors that affect crew motivation. By determining the strength of the links between motivational factors and crew motivation, a model for predicting and improving crew motivation can be developed. Future work on assessing and measuring crew metrics will be done to complete the proposed model shown in Figure 1. The model will be validated with actual data and used to determine crew performance based on motivational and other factors affecting crew performance. Agent-based modeling will be used to further implement the concepts in order to show the relationships between the individuals on the crew and crew performance, and to thus gain a better understanding of the dynamics of the crew as they relate to motivation.

7 CONCLUSIONS AND FUTURE RESEARCH

The first contribution of this paper is in providing a comprehensive review of motivation literature in both the construction and non-construction domains, identifying the shortcomings of construction literature about motivation, and identifying factors affecting crew motivation in construction. Identifying these motivational factors enables their effects on crew motivation to be analysed, which in turn leads to better prediction of crew performance. We reviewed past research on motivation in the general domain followed by a review of motivation literature in construction. We then provided a list of key factors that affect crew motivation based on the reviewed literature. Previous research in construction failed to provide a comprehensive review of motivational factors affecting crew workers even though the need for such a consideration has only been increasing in order to better predict crew performance. The second contribution of this paper is the presentation of a method for measuring crew motivation. We illustrate how it is possible to measure both motivational factors and crew motivation quantitatively. Quantifying crew motivation will help in analysing and evaluating crew motivation models, such as models for understanding the relationship between motivational factors, crew motivation, and crew performance.

This paper is part of a broader research study that intends to understand the effect of motivational factors on crew metrics. In future, the research presented here will be extended to develop crew metrics including not only crew performance indicators (e.g. productivity) but also other crew behavioral outputs (e.g. turnover, absenteeism, and safety [incidents]). Through our study, we will try to find the relationship between crew motivation and other crew performance metrics. A model of such relationships is presented in this paper. Future research will also focus on further analysing the relationships between motivational factors, crew motivation, and crew metrics by developing suitable theoretical models such as fuzzy agent-based models. Agent-based modeling and simulation (ABMS) is a powerful technique when dealing with attributes like human behaviour. On the other hand, fuzzy techniques are powerful when dealing with subjective data. Thus, future research will examine the possibility of developing fuzzy agent-based models to model the relationships between motivational factors, crew motivation, and crew metrics. Such models will allow the construction industry to achieve better predictions of crew performance.

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