AMERICAN UNIVERSITY OF BEIRUT

USING STRUCTURAL EQUATION MODELING TO STUDY THE FACTORS AFFECTING KNOWLEDGE SHARING INTENTIONS AMONG CONSTRUCTION WORKERS

by
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AN ABSTRACT OF THE THESIS OF

Hala Amer Sanboskani for Master of Engineering
Major: Civil and Environmental Engineering

Title: Using Structural Equation Modeling to Study the Factors Affecting Knowledge Sharing Intentions Among Construction Workers

Front line construction workers carry the hands-on knowledge required to execute projects. Accordingly, their productivity is a key player in defining project performance and this productivity is affected by several influences such as communication and knowledge sharing. However, there has not been enough research on the drivers of the workers' behavior towards knowledge sharing.

Considering the importance of the knowledge sharing process among construction workers and its significant effect on project performance, this study takes a closer look into the factors that affect the knowledge sharing process among blue-collar workers in the MENA region. The study aims at identifying the factors affecting the workers' intentions towards knowledge sharing upon assessing the relationships between these factors. This allows for a better understanding of the weaknesses in the process to suggest practical solutions for practitioners to make the communication process more efficient. Starting with factors from the literature, a questionnaire survey was prepared to record responses of construction workers to questions inquiring about their view of the work environment and the current practices of the knowledge sharing process. A total of 171 responses were collected from 16 construction building sites in Lebanon; out of which 137 were identified as usable.

Mixed methods analysis involving structural equation modeling and descriptive analysis were used to first extract the factors affecting knowledge sharing behavior, among which are contributions and project performance assessment. Second, upon running descriptive statistical analysis, these factors showed meaningful results that were analyzed to point out the weaknesses in the knowledge sharing process. To verify the context specific developed factors, these factors were compared with factors from the literature. Also, considering the context of application, suggestions such as giving feedback and appraising performance were discussed to improve the working environment for a better knowledge sharing process; hence, increased labor productivity and improved project performance.

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CHAPTER 1

INTRODUCTION

The major pillars of project performance in the construction industry are meeting the project's schedule while maintaining budget and not compromising quality (Thamhain 1992). One major contributor to these pillars is labor productivity that directly affects tasks' durations and hence the project schedule, and indirectly affects rework and therefore the project cost, and quality. In practice, construction falls behind other industries in terms of labor productivity (Kiomjian et al. In Press). Focusing on the past two decades, construction labor productivity started to fall due to hiring less skilled workers, facing shortages in material and equipment, and stretching management resources (O'Grady and McCabe 2014). A study by Vereen et al. (2016) showed that there is a consistent productivity decline in output per labor hour and per dollar cost from 1990 to 2008. As such, there is a need to consider and analyze its drivers and effects on project performance. Ideally, such studies should be done at level of blue-collar workers who are the major contributors to project's progress. Despite their importance, these workers suffer from lack of proper training and develop their skills from on-the-job training (Golden and Skibniewski 2009). Actually, they gain their knowledge by learning from their colleagues, mainly senior ones. This process of knowledge exchange and social interaction is referred to as knowledge sharing (Koskinen et al. 2003).

Considering the significance of workers' contribution to project performance, one would expect to have studies focusing on the knowledge sharing process that takes place on the level of blue-collar workers. Nevertheless, this is not the case in the construction industry where studies about knowledge sharing focus on the individuals at the higher level of the hierarchy such as project managers and engineers (Javernick-Will (2011); Kivrak et al. (2008); Poleacovschi et al. (2018); Othman et al. (2018); Zhang and Fai Ng (2012)). The lack of focus on blue-collars coupled with the absence of vocational training renders knowledge sharing as a more sensitive subject. The lack of vocational training indicates that there is no technical-systematic way of preparing the workers to perform their duties; hence no control over their behavior implying more uncertainties in their performance. This is specifically the case in the Middle East and North Africa (MENA) region (Srour et al. 2017).

Accordingly, such settings reflect the practical nature of the worker's knowledge that is difficult to codify and document (Koskinen et al. 2003), rendering it as tacit (Poleacovschi et al. 2018). Tacit knowledge resides in the minds of its bearers (Thomas et al. 1998), so its distribution is dependent on personality and social traits (Thomas et al. 1998). Consequently, it is important to understand the personal and social factors, which drive the transfer of tacit knowledge among workers on construction sites, to be able to maintain such knowledge.

Considering the importance of the knowledge sharing process among construction workers and its significant effect on project performance, this study takes a closer look into the factors that affect the tacit knowledge sharing process on the level of blue-collar workers such as affiliation and attitude. This is achieved by conducting a questionnaire survey that records responses of construction workers (foremen, skilled, and junior) to questions about their view and current practice of the knowledge sharing process. A total of 16 construction sites were visited in Lebanon collecting 171 responses, out of which 137 were identified as usable. The study aims at first identifying the factors that impact the knowledge sharing process among construction workers. Second, it aims at hypothesizing the relationships between these factors and determining whether all the underlying relations affect the workers' behavioral intentions towards knowledge sharing and, if so, in what way. The long-term goal of this study is to utilize such understanding of the workers' intentions towards knowledge sharing to suggest methods to construction professionals aiming to optimize the workers' individual and team behaviors reflecting on increased productivity hence improved project performance.

As mentioned earlier, the expected drivers of construction workers' intentions towards knowledge sharing are characterized by personal and social traits. Given the psychological nature of such factors and the complexity of their relationships, the mode of modeling and analyzing is selected to be structural equation modeling (SEM). The final results include a set of five factors playing a role in affecting workers' intentions towards knowledge sharing. These results were analyzed using mixed approaches of quantitative and qualitative analysis in comparison to literature and based on discussion with the workers. Finally, upon utilizing all the analyses done, ideas on methods to improve the knowledge sharing process and labor productivity were suggested.

In this work, the objectives will be tested in the context of the MENA region, so the literature review starts by highlighting the status of research focusing on labor in the MENA region. It is followed by an evaluation of the knowledge sharing process occurring between construction workers and the state of the art of research on knowledge sharing in the construction industry. This is followed by a detailed objective defining the scope of the study. Then a description of the research method takes place. This is followed by the analysis section that shows preliminary analysis of demographics and explains the model based on the questionnaire survey and presents the statistical results. Then, descriptive analysis takes place and the results for the final model are statistically assessed. After that, discussion of the results including theoretical implications of comparison with literature, assessment of hypotheses results, and suggestions for practical implications take place. The final section concludes with the limitations and summary of the research work as well as ideas for future works.

CHAPTER 2

LITERATURE REVIEW

This section examines the status of the construction industry with respect to the knowledge sharing process and highlights the main findings as well as gaps. It also sheds light on the construction industry in the MENA region stressing the need to invest in the knowledge sharing process in this region.

2.1 Overview of the Construction Industry in the MENA Region

Despite minute labor wages in the MENA region, labor costs constitute a considerable amount of project cost (El-Gohary and Aziz 2014; Kiomjian et al. 2016). For example, in the United Arab Emirates (UAE), the average monthly wage for construction worker is estimated to be $1,156 (Indeed 2020). The average monthly wage for construction worker in the United States (US) is estimated to be $2,837 which is about 2.5 times more than that at the UAE (INC. 2020). Hence, it is expected to have a larger portion of the construction costs in the US to be attributed to labor costs than that in the UAE. However, according to a study by Deloitte, labor wages remains the largest portion of construction costs in Dubai's construction industry (Deloitte 2016). Similarly, in the US, 65% of project cost is directed for labor wages (LLC 2019). This implies, regardless that the labor wage in the US is 2.5 times more than that in the UAE, labor costs in the MENA region still resemble the largest portion of the construction cost which could be attributed to rework, poor productivity, and lack of formal training.

The productivity curve on any construction project experiences rough starts due to the chaotic nature of the construction process in its early phases (Kolltveit and

Grønhaug 2004). Chaos occurs since workers need time to adjust to the new site and learn on the new project. This becomes more critical in developing countries, which is the case of countries in the Middle East and North Africa (MENA) region, where the industry already suffers from multiple disadvantages (Othman 2014). This is because the workers have to "reinvent the wheel" at the start of every project due to the severe absence of formal training programs(Sanboskani et al. 2020)(Sanboskani et al. 2020)(Sanboskani et al. 2020)(Sanboskani et al. 2020)(Sanboskani et al. 2020)(Sanboskani et al. 2020). To overcome such inefficiency, workers are expected to reuse knowledge accumulated during previous projects. To be able to sustain knowledge capital, management must ensure that tacit knowledge is efficiently shared between workers with varying skill levels. If knowledge is properly shared, construction organizations will be able to meet the challenges of the contemporary market requiring faster, more cost effective, and higher quality projects (Woo et al. 2004). In contradiction to the requirements of the modern market, construction projects in the MENA region still deliver projects late and over budget giving rise to very costly claims and disputes (EMAM et al. 2014). Zooming into the causes of these pitfalls reveals that they are highly correlated with poor labor productivity in this region (ABDELAAL et al. 2014).

As mentioned earlier, addressing the low labor productivity could be done via understanding and thus enhancing the knowledge flow among the workers. The importance of knowledge sharing coupled with the scarcity of studies tackling the MENA region necessitate studying the knowledge sharing process in this specific region.

2.2 Process and Extent of Knowledge Sharing among Construction Workers

The construction industry relies on blue-collar workers since they are responsible for the bulk of the work performed on a construction project. Workers hold most of the hands-on knowledge required to complete a project. Studies indicate that labor costs represent 30 to 50 percent of the overall project's costs (McTague and Jergeas 2002). To reduce labor costs hence improve project performance, a number of possible solutions must be investigated, one of which is enhancing labor productivity (Jarkas and Bitar 2011; Kazaz et al. 2008). Labor productivity is dependent on a number of factors such as experience, knowledge, and learning (Kiomjian et al. 2016).

Learning in construction typically refers to "learning on-the-job" which is how blue-collar workers develop their skills and knowledge (Golden and Skibniewski 2009). On-the-job learning has both individual and social aspects (Collin and Valleala 2005). The individual aspect is represented by the worker's own effort of repeating tasks (Srour et al. 2018). Srour et al. (2018) showed that this is driven by task characteristics such as complexity and mechanization along with workers' professional characteristics such as skills and previous experiences. The social aspect of learning, on the other hand, is resembled by interaction and exchange of knowledge among crew members (Kiomjian et al. In Press). Social aspect is driven by schedule structure, worker's previous experience, crew demographics, and worker's personal traits (Kiomjian et al. In Press).

Understanding the dynamics of learning requires understanding the concept of knowledge sharing. According to Bock et al. (2005), knowledge in this context is the individual's professional experiences and know-how that help him/ her in performing professional tasks. Hence, knowledge sharing is the transfer of knowledge from one individual to the other through informal discussions and chats, formal meetings, and information management systems (Bock et al. 2005). Depending on the type of knowledge at hand, this knowledge sharing process can take place in several modes. Explicit knowledge and implicit knowledge are the two main knowledge categories (Su and Contractor 2011). Explicit knowledge is also known as codified knowledge since it can be easily expressed in words and accordingly documented in textbooks (Polanyi 1966; Zhang and He 2015). For example, it is used in engineering and construction in documenting drawings and following standards. Implicit or tacit knowledge, on the other hand, is contextual and is initiated from individuals' intuition, know-how, and experience which makes it difficult to document but flows easily to explain through social and verbal interactions (Koskinen et al. 2003; Polanyi 1966). For example, tacit knowledge takes place when project members share their expertise to find solutions or execute tasks. Hence, the wide majority of knowledge transferred by workers on construction projects is tacit (Poleacovschi et al. 2018). Tacit knowledge is embedded in the minds of its bearers which means informal verbal communication is the media for sharing it (Thomas et al. 1998).

The informal nature of the knowledge sharing process makes it under the control of the knowledge sender and knowledge receiver (Thomas et al. 1998). Hence, it is highly dependent on interpersonal behavior of its participants (Thomas et al. 1998). Considering the social aspects of on-the-job learning and the practical nature of tacit knowledge, the knowledge sharing process among construction workers is expected to be driven by a number of social and personal factors.

One of the earliest seminal studies addressing the antecedents of knowledge sharing is done by Bock et al. (2005) who assessed the factors that affect employees' intentions and behaviors to share knowledge. These include extrinsic motivators, social-psychological forces, and organizational climate factors. To support or reject a set of hypotheses, Bock et al. (2005) conducted a survey on 154 managers in Korean organizations. The results showed that organizational climate, subjective norms, and attitudes toward knowledge sharing affect individual's intentions to share knowledge. Attitudes, in turn, are affected by anticipated reciprocal relationships, and subjective norms are affected by sense of self-worth and organizational climate. On the other hand, attitudes towards knowledge sharing are negatively affected by anticipated extrinsic rewards.

In this study, an approach similar to the seminal work of Bock et al. (2005) is adopted by focusing on the "expected" factors that could translate construction workers' behavior towards the knowledge sharing process. The term "expected" is used to account for the difference in culture and work characteristics of the blue-collar workers from their white-collar counterparts. It could be logical to assume that the distribution of the factors might vary from what was concluded by Bock et al. (2005) work. These factors include personal characteristics, internal drivers, organizational drivers, and social drivers(Sanboskani et al. 2020)(Sanboskani et al. 2020)(Sanboskani et al. 2020)(Sanboskani et al. 2020)(Sanboskani et al. 2020)(Sanboskani et al. 2020). The expected drivers may be sub-divided into more specific factors as extracted from literature.

Personal characteristics are the laborer's characteristics, inclusive of age, expertise, position, tie strength, education levels, language, and cultural differences (Poleacovschi et al. 2018). The sub-factors of the other drivers are defined in what follows.

Internal drivers can be inclusive of sense of self-worth and attitude(Sanboskani et al. 2020)(Sanboskani et al. 2020)(Sanboskani et al. 2020)(Sanboskani et al. 2020)(Sanboskani et al. 2020)(Sanboskani et al. 2020). Sense of self-worth highlights how much the worker views his knowledge sharing as valuable and efficient to the project (Gardner and Pierce 1998). Attitude measures how much positive feelings the worker has for sharing his knowledge (Price and Mueller 1986).

Organizational drivers can be inclusive of fairness and affiliation. Fairness identifies whether the worker trusts his supervisor's actions and decisions (Kim and Lee 1995). Affiliation recognizes the level of sense of "togetherness" among the workers which reflects pro-social behavior and their willingness to help each other and engage in effective team processes (Kim and Lee 1995; Mitropoulos and Memarian 2012).

As for social drivers, they can be inclusive of anticipated reciprocal relationships and subjective norms(Sanboskani et al. 2020)(Sanboskani et al. 2020)(Sanboskani et al. 2020)(Sanboskani et al. 2020)(Sanboskani et al. 2020)(Sanboskani et al. 2020). Anticipated reciprocal relationships show worker's stance of whether knowledge sharing is viewed to him as a mean to maintain relationships with other project members (Deluga 1998). Subjective norms measure two components: the degree to which the worker thinks his supervisor and colleagues expect him to act on knowledge sharing, and the degree of worker's motivation to comply with the supervisor and colleagues' directions (Fishbein and Ajzen 1981).

Using the aforementioned factors to study the construction workers' view and representation of the current practice of knowledge sharing on construction sites is not enough since it targets the factors as independent items. Hence there is a need to consider their underlying relationships that reflect on the worker's intention to share knowledge. Intention to share knowledge is how much the worker believes that he will actually share implicit knowledge in the future (Dennis 1996).

According to Ajzen (1985), intention is governed by external and internal factors. This intention determines behavior or in other words it is expected to predict an individual's attempt to perform an action. The relationship between attitude and intention in addition to the impact of the latter on behavior are covered by the theory of reasoned action (TRA) (Fishbein and Ajzen 1980). Later on, TRA was extended by theory of planned behavior (TPB) to accommodate the effect of beliefs on attitude (Ajzen 1985).

Hence, to develop an understanding of the workers' intentions to share knowledge it is significant to use the factors mentioned above in studying workers' standpoint on communication. The analysis of this understanding will be used to suggest procedures to optimize the construction workers' attitudes towards the knowledge sharing process. Such approaches can include empowering leadership (Xue et al. 2011), assigning crews in a certain formation (Kiomjian et al. In Press), allocating certain tasks to certain individuals/ crews (Hosseini and Akhavan 2017), giving incentives (Collins and Clark 2003), appraising performance (Liu and Liu 2011), and empowering affect-based and cognition-based trust among co-workers (Holste and Fields 2010). Applying such methods among others will surely increase labor productivity. In their turn, more productive laborers mean less time spent on construction. This implies reducing labor costs as well as indirect costs of rework, overhead, and contractors' expenses on human and equipment resources. In addition to that comes the practical benefits such as smoother labor profile due to less hiring and firing.

2.3 Knowledge Sharing in the Construction Industry: State of the Art

Similar to the work of Bock et al. (2005), several researchers have studied the status of knowledge sharing in the construction and engineering industry. Table 1 below highlights some of these studies with summary description of their objectives, the country they were based in, and the professional level of their participants.

Table 1: Studies on Knowledge Sharing in the Construction Industry

Study	Main Objectives	Location	Participants' Professional Level
Alashwal et al. (2011)	Determining the factors that obstruct and enable knowledge sharing among project teams of fragmented firms in the construction industry	Malaysia	Project managers, construction managers, directors of projects, and architects
Gardiner (2016)	Exploring the influences for individual professionals and paraprofessionals to share their deep, personally constructed knowledge, in a public sector provider of railways infrastructure	Australia	Supervisors, managers, graduate trainees, and cadets
Issa and Haddad (2008)	Understanding the factors that affect knowledge sharing in construction organizations for successful implementation of knowledge sharing as part of organizational knowledge management initiatives in construction organizations	United States	Company presidents, CEOs, vice presidents, HR managers and directors, project managers, business development managers, and employee relations coordinators
Javernick-Will (2012)	Understanding the motivators driving knowledge sharing participation in construction and engineering organizations	United States, United Kingdom, Sweden, Greece, Japan, Canada, and Finland	Executive managers, knowledge managers, project managers, and project engineers
Kivrak et al. (2008)	Understanding the drivers and barriers for knowledge management and the methods used for capturing and sharing explicit and implicit knowledge in construction contracting companies	Turkey	General managers, business development managers, and bid proposal managers

Ni et al. (2016)	Studying the influence of knowledge sharing culture on knowledge sharing performance among project members and mediating effect of project-team interaction between knowledge sharing culture and knowledge sharing performance among project members within the project management organization	China	Project members from project management organizations
Othman et al. (2018)	Studying the critical success factors in implementing knowledge management in consultant firms for construction industry	Malaysia	Engineering consultants at construction firms
Poleacovschi et al. (2017)	Analyzing how knowledge sharing connections can save time on employees seeking knowledge from other colleagues	United Kingdom, New Zealand, and United States	Employees in construction and engineering organization
Poleacovschi et al. (2018)	Understanding the impact of organizational control on tacit and codified knowledge accessibility in engineering organizations	North America	Engineers, architects, and scientists
Saini et al. (2018)	Determining the critical success factors associated with the effectiveness of transfer and sharing of tacit knowledge in lean and agile construction processes	United Kingdom	Project managers, executives, and consultants
Zhang and He (2015)	Studying the critical factors affecting tacit knowledge sharing within integrated project team	China	Building engineers, project managers, and project management office staffs
Zhang and Fai Ng (2012)	Studying the factors affecting knowledge sharing attitudes in the construction industry	Hong Kong	Project managers, site agent engineers, quantity surveyors, and safety managers
Zhang and Ng (2013)	Studying the antecedents of knowledge sharing and their impact on knowledge sharing attitude and intention	Hong Kong	Professionals working in construction teams

Although Table 1 does not show the methodology carried out in each study, most of these studies were based on a questionnaire survey answered by the mentioned participants. Hence, it is worth noting that the mode of analysis used by a number of these studies is SEM.

Most of these studies focused on the factors that could affect the knowledge sharing process that happens among white-collar employees in the construction and engineering industry. These employees include, from the top of the white-collar pyramid to its bottom: CEOs, HR managers, projects' directors, consultants, business development managers, architects, engineers, project managers, construction managers, supervisors, site agent engineers, quantity surveyors, and safety managers. These studies do not pay significant attention to the knowledge sharing process among blue-collar workers, who are at the frontline of construction. Furthermore, they cover various countries (e.g., United States, United Kingdom, and China); however, they do not cover the MENA region. Hence, there is a need to understand the knowledge sharing process on the level of blue-collar workers, particularly in the MENA region.

CHAPTER 3

RESEARCH OBJECTIVES AND METHODOLOGY

The review of relevant literature in Section Two targeted a good number of studies on knowledge sharing among white-collar employees in the engineering and construction industry from different angles. Some studies focused on the factors affecting the knowledge sharing process, while others focused on the critical success factors associated with knowledge transfer. However, none targeted the factors that drive the intentions of construction workers to share their tacit knowledge. Accordingly, the objective of this study is two-fold. First, it aims at identifying the factors that affect construction worker's behavioral intentions towards knowledge sharing; hence, determining the underlying relations between these factors to assess their impact on the knowledge sharing process. Second, it aims at suggesting strategies to optimize workers' behaviors and exploring some of the practical implications of understanding the worker's intentions to share knowledge on the overall project performance. This is done through a survey with a set of questions targeting foremen, skilled workers, and junior workers at new and renovated building construction projects. Lebanon was chosen as a test bed for the study. In order to fill the literature gaps in a manner that considers the psychological interactive nature of the collected data along with the set of hypotheses developed on the expected factors, modelling and analyzing the results will be done via SEM. Further assessment of the factors will be done using descriptive analysis and comparison with studies from the literature. Weaknesses in the individual and team behavior of the workers in the MENA region will be identified from the descriptive results to suggest ideas to overcome such weaknesses. Moreover, the status for the hypotheses will be assessed and such assessment will feed into suggesting methods to optimize workers' behavior towards knowledge sharing. Figure 1 illustrates the developed thinking methodology of this study.

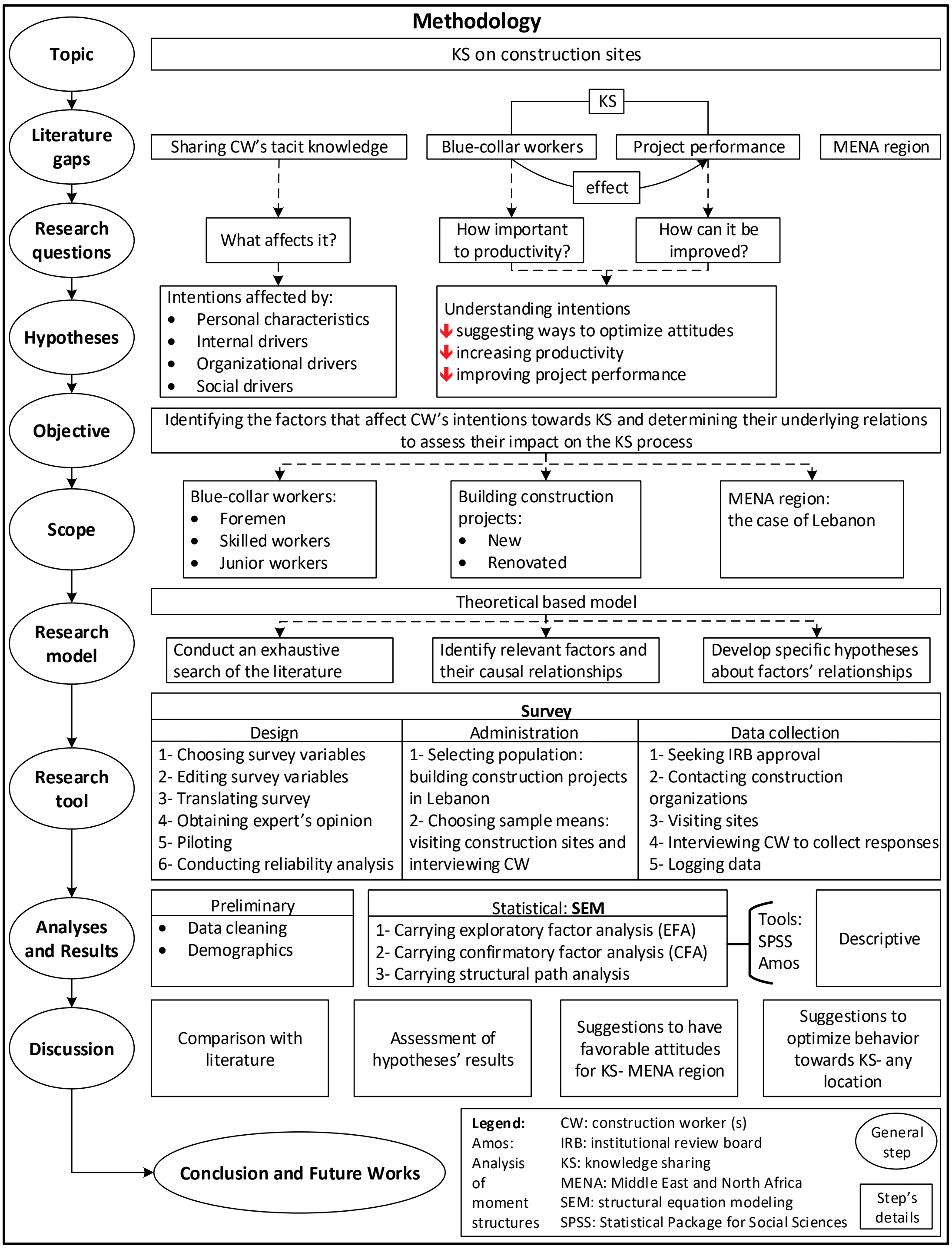


Figure 1: Methodology of study

A number of the steps shown in Figure 1 were discussed in previous sections, starting with the identification of the topic. This was followed by a thorough literature review of the studies falling under the umbrella of the topic at hand to identify the drivers of the study or what are referred to as the gaps in the literature. The literature review was used to develop a set of research questions addressing gaps in the literature as well as formulating a set of corresponding hypotheses. The rest of the steps will be discussed and further expanded on in the following sections of the study.

3.1 Research Model and Hypotheses

As mentioned earlier, several factors are expected to drive construction worker's intentions to share knowledge. Nevertheless, as indicated in the early parts of this section, this study does not only focus on identifying these factors but also on determining the underlying relations among them. This is supported by the fact that some factors might have direct and indirect effects on intentions and some factors might be affecting each other's. The directions and significance of these relationships are not yet clear when it comes to the construction industry. Accordingly, this sub-section will focus on establishing a construction specific theoretical based model that highlights these relationships by developing a set of specific hypotheses. This sub-section explains the grounding of these relationships from literature.

Before discussing Table 2 that presents the developed set of hypotheses and Figure 2 that depicts the original hypotheses model of the interrelations of the factors affecting knowledge sharing intentions, the research team will explain some theory on innate attitude and its role in defining this model. Some people are extroverts in nature and like to talk about their experiences and thus help others without waiting for anything in return. This tells about their attitude towards knowledge sharing, meaning they already have positive attitude towards sharing knowledge regardless of the setting, the reason, and the environment. This aligns with the discussion of Calder and Staw (1975) on how altruistic intrinsic motivation originate in certain individuals who like to engage in knowledge sharing exercises for the sake of personal enjoyment and challenge. This is further asserted by the study done by Javernick-Will (2012) where upon carrying interviews with engineering managers from companies, they highlighted how some individuals are natural knowledge sharers that value knowledge sharing for its own sake.

However, in this study and model, the research team is not targeting the innate attitude, but is focusing on how this attitude is altered after being affected by a certain set of factors corresponding to the setting of the job. This means, the research team wants to study how the working environment, the construction workers are put in on construction sites, shapes their attitudes towards knowledge sharing in this context. The support to each hypothesis is presented in the following paragraphs.

Table 2: Developed Set of Hypotheses

Hypothesis ID	Hypothesis
H1	The degree of fairness within the team affects the worker’s degree of affiliation with the team.
H2	The degree of fairness within the team reflects on the worker’s compliance with subjective norms.
H3	The worker’s sense of belonging to the team (affiliation) affects his sense of self-worth.
H4	The worker’s degree of affiliation to his team affects his compliance with subjective norms.
H5	Higher sense of self-worth is associated with better attitude towards knowledge sharing.
H6	Enhanced anticipated reciprocal relationships have a positive impact on worker’s attitude towards tacit knowledge sharing.
H7	Subjective norms mediate the relationship between both team affiliation and fairness with attitude towards knowledge sharing.
H8	The worker’s subjective norms play a role in controlling his intention towards sharing knowledge.

H9	Worker's attitude towards knowledge sharing is positively correlated with the worker's intention to share knowledge.

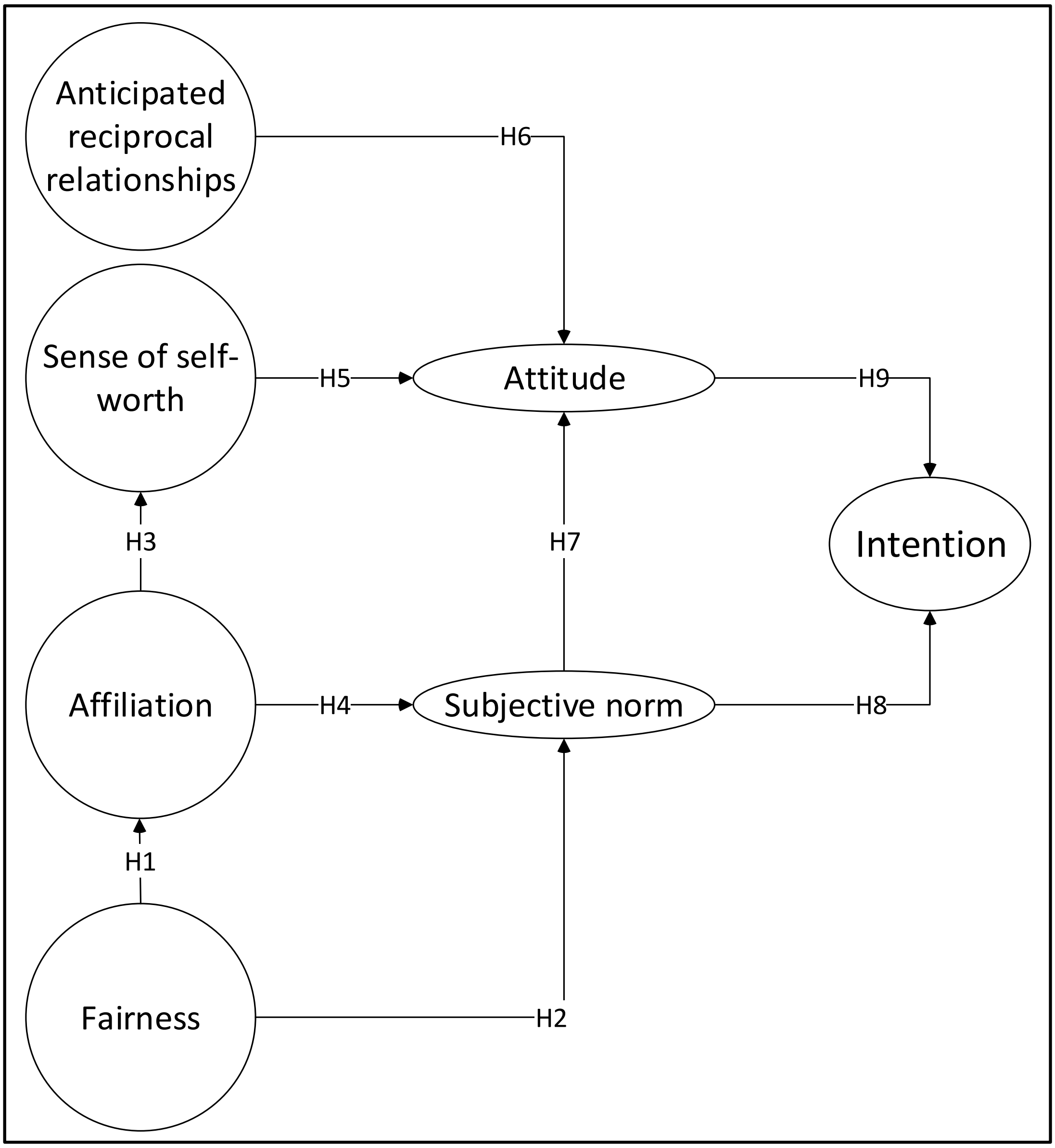


Figure 2. First hypotheses model for the factors affecting knowledge sharing intentions

H1: According to Bock et al. (2005), fairness and affiliation are both aspects of organizational climate. On one hand, a worker's feeling of fairness is the assertion that organizational practices are equitable and not arbitrary (Koys and DeCotiis 1991). This leads to increased level of trust between members of the same team. On the other hand, a worker's sense of affiliation is the feeling of "togetherness" that he develops within the team (Kim and Lee 1995). According to O'Reilly (1989), when the team members share mutual trust and respect, they are more likely to feel strong team spirit.

H2: According to Schneider et al. (1996), the feelings of members of the organization are built upon the policies and procedures practiced by their supervisors. Hence, the nature of such policies and procedures determines individual's perception of fairness. Such perceptions reflect upon the organizational climate leading to better compliance with subjective norms (Tohidinia and Mosakhani 2010).

H3: When a team member feels affiliated with a group, he feels appreciated and that he is a contributing member to the group. Such perception of contribution boosts his sense of self-worth (Bandura and Self-efficacy In 1994).

H4: According to Xue et al. (2011), more cohesive teams have more caring members. Hence, they would tend to comply with the expectations of their colleagues.

H5: If a worker is convinced with the benefits of his knowledge, he will have a favorable attitude for sharing it with others due to the positive expected impacts (Zhang and Fai Ng 2012).

H6: According to Organ and Konovsky (1989), any mode of social exchange would establish friendships beyond economic benefits. Worker views such implications as anticipated reciprocal relationships. Accordingly, this work proposes that such effect of social exchange would improve the worker's attitude towards knowledge sharing.

H7: Social norms rely on two constitutes, the way the worker perceives his supervisor and colleagues' expectations and the influence of these expectations on his willingness to meet them (Fishbein and Ajzen 1981). Accordingly, if the worker is motivated to comply, he will have a favorable attitude towards knowledge sharing (Tsai et al. 2012).

H8: Given the rigid hierarchy on construction sites and the impact of supervisor's expectations for the workers to share knowledge, they are more likely to comply with the expectations. Such compliance with subjective norms will increase their intentions to share knowledge (Lin and Lee 2004).

H9: An individual with a positive attitude towards an action will most probably intend to do it (Ajzen and Fishbein 1977).

3.2 Research Tool

Selecting a research tool must be aligned with the topic's nature and the field under study along with the cultural and educational background of the participants. This research follows the positivist paradigm which according to Grix (2018) demands using quantitative methods to test hypothetical deductive generalizations. Moreover, this study represents an area where there is enough knowledge to pose hypotheses and formulate theoretical framework; hence, quantitative research suits it (Amaratunga et al. 2002). Considering the aforementioned reasons and the ability to access a large number of participants, the research team decided to use questionnaire survey to collect data. This sub-section describes the survey design and administration process that took place along with the data collection method.

3.2.1 *Survey Design*

The survey design process entailed several steps. First, the research team conducted a thorough review of the literature tackling knowledge sharing at the individual level and selected a model questionnaire survey developed by (Bock et al. 2005). The questions focus on the possible factors that can be driving knowledge sharing intentions. The following step was to edit the selected survey by removing sections and sub-sections that are irrelevant to the construction industry and by modifying some terms to make them more construction specific. For example, “department” was replaced with “team” and “organization” with “project”. The survey was translated, by a professional academic translator, from English to Arabic to match the native language of the participants. The translated version was examined by two construction professionals, an engineer with 12 years of experience and an architect with six years of experience to make the necessary changes by obtaining experts’ opinions. The professionals have rich experience of construction management practice.

The final version of the survey contained eight sections (Appendix A). The first section, which was added by the research team to collect personal characteristics that could help in linking the results to crew demographics, captures the participants’ background information, such as their gender, age, education, experience, and position entitled. The six middle parts inquired on the expected drivers of knowledge sharing and required the participants to provide their assessment of the current situation using 5-point Likert scale. It includes questions resembling anticipated reciprocal relationships, sense of self-worth, affiliation, fairness, attitude, and subjective norms. Although this work focuses on individual behavior, the inclusion of factors pursuant to affiliation and social norms accommodate for team level processes. These constructs are typically studied under the umbrella of team behavior and are known to drive behavior at the individual level (Mitropoulos and Memarian 2012; Salas et al. 2008). The final section captures the participants' intentions to share knowledge in the future.

As shown in Figure 3, the items are divided into seven groups: anticipated reciprocal relationships (items ARR1 to ARR4), sense of self-worth (items SSW1 to SSW4), affiliation (items Aff1 to Aff4), fairness (items Fair1 to Fair3), attitude (items Att1 to Att5), subjective norms (items SN1 to SN5), and intentions (items Int1 to Int3) (Bock et al. 2005).

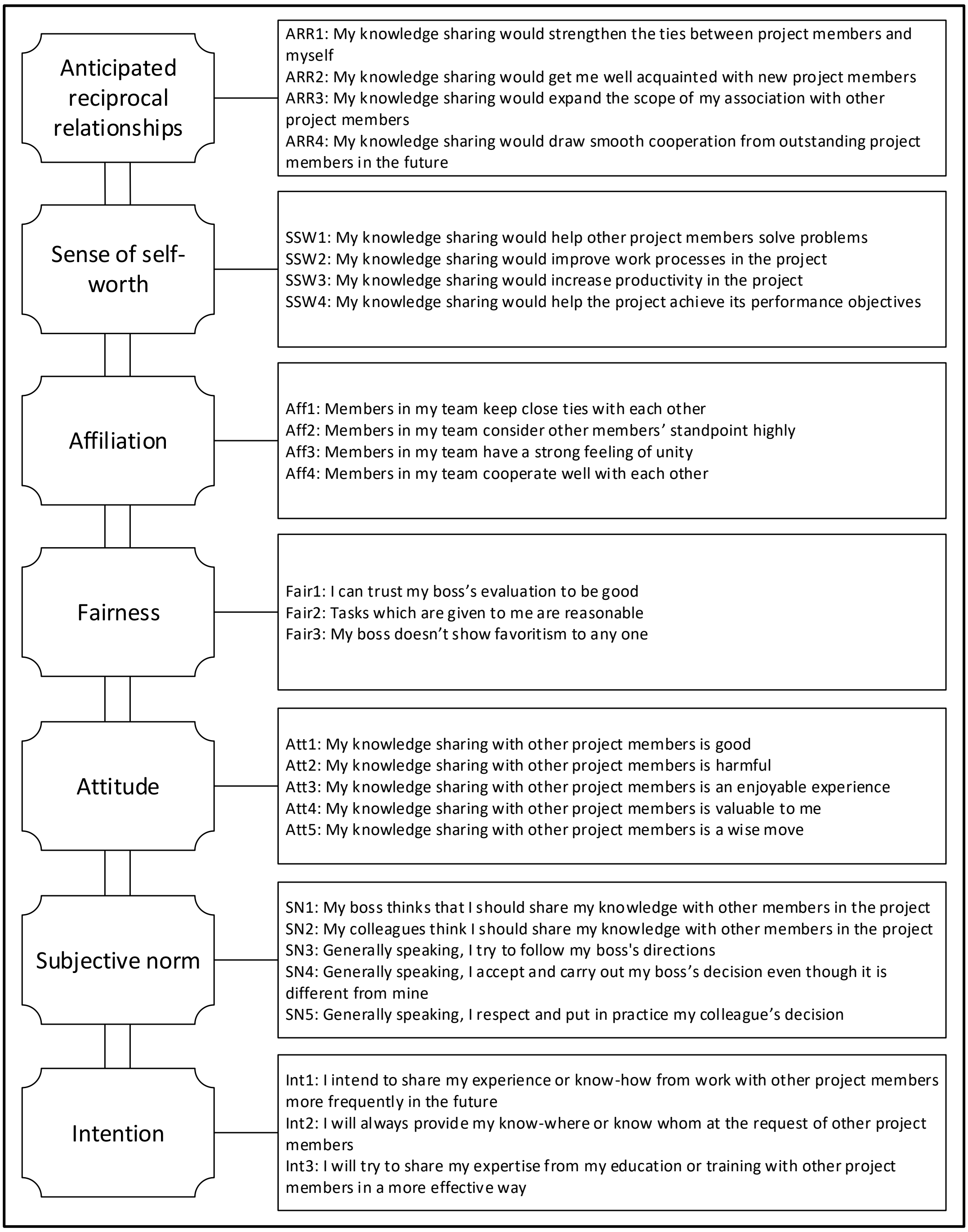


Figure 3: Factors affecting knowledge sharing and their indicators

The survey was piloted on a renovation project of a residential structure with a total built-up area of 3,423 m2. The questions were answered by 13 workers including foreman, skilled workers, and junior workers. The main purpose of piloting was to examine whether the respondents understood the questions. Also, the behavior of the participants was observed to mark the impediments encountered by them while filling the survey. Such notices were considered along with the experts' opinions to edit the survey and develop the final version for data collection.

Before carrying on with data collection, the results of the piloted survey were tested for internal consistency (reliability) using the values of Cronbach's alpha. As suggested by Wang et al. (2014), a Cronbach's alpha value of 0.70 or more is considered acceptable. The various sections yielded values for Cronbach's alpha ranging from 0.72 to 0.90 with a mean of 0.82. Thus, they all surpass the acceptable threshold.

3.2.2 *Survey Administration*

As mentioned in the objective, the research team chose Lebanon as a case in the MENA region. Hence, the population selected to conduct the survey on is building construction projects in Lebanon. They could be new or renovated projects.

Given the nature of the questions and the likelihood of participants to face difficulties in completing the questionnaire, the research team collected the data personally by visiting buildings construction sites and explaining to the workers the aim of the study and the survey. A random set of buildings under construction was selected.

3.2.3 *Data Collection*

Considering that this study involves human research participants, the research team had to seek for the approval of the institutional review board (IRB) at AUB to be able to carry on with the data collection. This involved taking tests, applying approval forms, and finally receiving the IRB's consent on performing such a study.

The team, then, contacted representatives of construction organizations to arrange for site visits. Research team comprised of three students conducted site visits over a period of two months where each site was visited once. During each site visit, the team explained the objective of the study and what is required to do by the workers to participate in the survey. Sometimes the workers were able to fill the survey themselves. In other cases, the research team had to interview the worker to be able to record his responses to the questionnaire along with justification to the answers given. The time needed to fill the survey varied between eight to 15 minutes depending on whether the respondent is filling the survey himself or is read the survey and is giving the answers orally.

Considering that the data collected is in hard copies, the research team logged in the responses of every project after the site visit was completed. This was done through a Google form depicting the survey and then the records were aggregated in an excel table form where all the records have been entered (Appendix B).

Checking the number of construction permits issued by the Order of Engineers and Architects in Lebanon for 2018, showed that about 90 percent of the permits were for residential, commercial, and educational buildings (Architects 2018). Accordingly, the research team visited a total of 16 building sites, most of which were in Beirut. They are of different sizes and scopes inclusive of medium sized buildings to towers and blocks and inclusive of residential, commercial, and educational facilities. Some of the projects involved new construction projects, whereas others were renovation projects. The total number of collected responses is 171, out of which 137 were identified as usable/ complete yielding a response rate of about 80 percent. Details about the choice of sample size are provided in the Statistical Analysis section. A sample filled survey is provided below (Appendix C). It is important to note that due to the male dominated nature of the construction industry in the MENA region, all of the survey participants are males.

CHAPTER 4

ANALYSIS METHODS

This section provides a preliminary analysis conducted on the collected data followed by a description of the statistical analysis done.

4.1 Data Processing and Preliminary Analysis

In this document, preliminary analysis is inclusive of description of the data cleaning method along with analysis on the demographics of the survey participants.

4.1.1 *Data Cleaning*

The mode of data collection in this study is by paper questionnaires distributed to construction workers or via verbal responses which is done by the research team interviewing them. An important point for the success of the data capturing is the design of the data collection instrument and its functionality (Jones and Hidiroglou 2013). For instance, having clear instructions explaining what the survey is about and what is expected from the respondent for each question. This is satisfied by the design of the survey used in this study, since there is a precise introduction stating the objective of the survey and summarizing the idea. For the demographic section, it is clearly specified that the respondent answers by choosing one range where his characteristic falls for each question. There are clear instructions at the beginning of the questions' section in the survey stating what each answer (value) stands for and that it is required to choose one grade for every statement posed. For the data capture process, it is not guaranteed that no errors occur when the respondents are filling the surveys themselves since they might skip questions, sections, or even pages and this is a writing error (Jones and Hidiroglou 2013). However, had the research team interview the worker, all the questions are guaranteed to be answered; however, not all of them are useable had the respondent answered in a contradictory manner for certain questions or had the interviewer misheard or made a mistake in keying the answers (Jones and Hidiroglou 2013).

The data is not transferred by any means but collected by the research team on the spot from the construction sites. Surveys were put in separate files, based on the site they are collected from, documenting the date and time of visit, and name of site, and number of surveys conducted.

Processing of the data captured starts by manual data keying to save them electronically (Jones and Hidiroglou 2013). This is done by entering the data by the research team to the electronic questionnaire form and the paper questionnaires are given ID numbers for future reference in analysis and data tracking for cleaning. The possible sources of error here would be in keying (Jones and Hidiroglou 2013). However, the original paper copies are always archived for double checking the data entry process.

De Waal et al. (2011) identified five types of record-level data errors that can be categorized into two groups based on how they are detected either via edits with fixed rules and they are part of data validation or they are statistically edited. The first group includes missing values, systematic errors, and random errors. The second group includes influential errors and outliers. In practice, data validation is carried out before statistical editing (Jones and Hidiroglou 2013).

Missing values occur in two forms either a field that is expected to be filled is not filled referred to as true missing field or a field that is not expected to be filled (skip-level question) is actually filled by the respondent referred to as false missing field. The latter will not be detected in this survey since it does not have skip-level questions. Systematic errors are those systematically reported by respondents and this happens in a case where the respondent keeps on answering the questions with a certain scale and unit while they have changed. This type of error will not be detected in this study since the questions have consistent scale. As for the random errors, they occur accidentally either by the respondent or the interviewer during initial data capture or during data capture processing (Jones and Hidiroglou 2013). There are certain edit rules to detect whether the data are in error and thus to detect which fields are in error. The edit rules are specific to the survey itself for example having certain questions to sum up to a certain value in another field (Jones and Hidiroglou 2013). In this study the rule is using the "tricky question" which is a question in the sixth field that has a negative denotation and answering it with a value similar to the questions of the rest of the section indicates that the respondent was not fully aware of this specific question, section, or perhaps the whole study. This is because in this question in particular "My knowledge sharing with other project members is harmful", the respondent should have an opposite response than the questions in the rest of the section or else he is not focused while responding. Influential errors are not checked for in this study since there are no cases of unusual large values or cases of large weights for certain samples (Jones and Hidiroglou 2013). As for outliers they are numerically distant observations from the rest of the data (Jones and Hidiroglou 2013). There are two types of outliers as identified by Chambers (1986), those that are correct observations with similar units in other population and referred to as representative outliers. The second type is the non-representative outliers that are incorrect or unique. Incorrect outliers are those with a very large value with respect to their true value (Jones and Hidiroglou 2013). Unique and incorrect outliers must be removed from the data to damp their effects. Detecting outliers should be based on robust estimates of the centrality and dispersion parameters (i.e., variance) which is done in statistical analysis part (Jones and Hidiroglou 2013).

Micro-errors are identified by using two categories of edits, the data validation edits and the statistical edits (Jones and Hidiroglou 2013). The first category includes certain hard and soft edits (Jones and Hidiroglou 2013). Hard edits are those that identify fields that are probably incorrect, while soft edits identify fields in error, but most probably are correct. There are several types of data validation edits inclusive of validity edits that check for missing values such as tracking the questions that were not filled by the respondents and consistency edits that compare different answers within a record to check for the logical consistency such as checking the answers of several similar questions within a section. Range edits are those that report whether the obtained values are outside of their bounds which is not the case in this study since the survey is done on the Likert scale. Logical edits are those specified by linear equalities and inequalities that result in an acceptance region for the values (Jones and Hidiroglou 2013). This type of edit will not be performed in this study since it is all done on the Likert scale. As for the second category (statistical edits), they are divided into four types. First, the statistical edits detect values that are probable to be wrong and this is done by comparing to estimated distributions from historical datasets which does not apply in this study. Second, the quartile method which is a procedural measure to detect outliers to a certain defined bound. Third, Hidiroglou–Berthelot Method is another method for detecting outliers using a transformation (Hidiroglou and Berthelot 1986). Second and third edits do not apply to this study. Forth, selective or significance editing chooses records in error for follow up had the selected records have a significant effect on the statistical estimates. In this study, the research team checked for the consistency between choice of age and choice of years of experience. For example, if a worker chooses an age range of 16-25 years and experience range of 25-29 years, it is illogical, so this is considered an error.

There are several steps or procedures to treat microdata errors (Jones and Hidiroglou 2013). Estimation, imputation, and automatic or interactive methods are examples of treatments. Systematic and random errors are usually treated by automatic and intervention methods. Automatic treatment takes place via an editing tool to deal with known, generally systematic type errors. Whereas, interactive methods happen via human intervention to review flagged errors and make judgments on how or if they should be corrected. There are problems with such method since it might create more errors. Usually the error is flagged for further review and the editing staff will work on it differently depending on how the data were collected. For data collected using paper questionnaires, the staff will have to make a judgement based on previous responses to see if the record is in error. Accordingly, they decide whether they must contact the respondent, or it can be passed. Hence, the editor might ask the survey organizers to try to get back in contact with the survey respondents to ask them to fill the missing fields for example. In this study this treatment method will not be applicable because the surveys are filled anonymously, and the survey collectors cannot contact the respondents for any further clarifications. So, the interactive method can only lead to deciding if the error can be passed, and if not then dealt with according to the editor's judgement or using another treatment. After this process, usually the “data are loaded into the survey datafile” and errors such as outliers, influential errors, and missing data might still be present to be treated by estimation or imputation.

A different treatment method is suggested for records that fail at being treated automatically and interactively or for outliers and missing values (Jones and Hidiroglou 2013). One way to deal with missing data is doing nothing about it, just labelling it in the data file for the data analyst to decide what to do. This approach is adopted when it is difficult to impute/ assign values for the missing data. A second approach would be adjusting the survey weights for nonresponse, but the drawback is adjusting weights as many as the missing fields. A third approach would be imputing missing data within individual records.

Logical (or deductive) imputation uses logical constraints and reported values within a record to deduce missing values. Using it is risky in this study since not all answers have a certain trend and the answers are relative to the case of the respondent. Mean-Value Imputation assigns the missing value the mean of the reported values and it should be used only for quantitative variables. The variables in this survey are not of the quantitative type. Historical Imputation relies on reported values for the same missing unit from previous occasions. This method is certainly not applicable to this study since it is unique. Sequential Hot-Deck Method needs an ordered data items according to a certain criterion to be able to assign the missing value the corresponding value from the preceding responding unit in the datafile. It is not applicable in this case since the data values are random within the provided Likert scale for the posed questions. Nearest-Neighbor Imputation uses data from neighboring records by minimizing a certain measure of distance. Ratio and Regression Imputation Methods use secondary variables to replace missing values with a predicted value that is based on a ratio or regression. For this method to be effective the response variable needs to be continuous. In regression method, “the independent regression variables may be continuous or dummy variables if they are discrete”. A disadvantage of this method is that the distributions of the overall dataset may have spikes, as mentioned in (Jones and Hidiroglou 2013). Accordingly, in this study the research team decided to delete the whole response when there is a missing data.

In summary, the data cleaning process that took place in this study involves the following:

- Removing responses with positive responses in the “attitude” section for all the questions or with negative responses for all the questions in that section
- Removing responses with inconsistent answers between age range and experience range
- Removing responses with missing answers to one or more questions

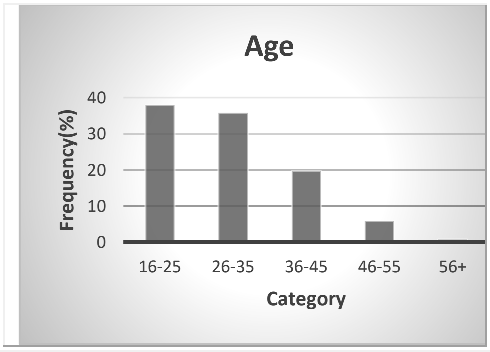
4.1.2 *Demographics*

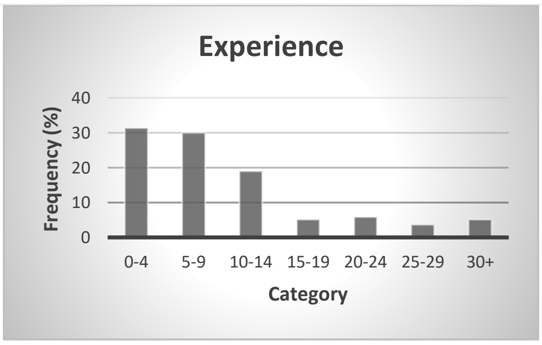
After doing the necessary data cleaning and having a total of 137 usable responses, the demographics of the respondents were checked to help summarize the data and validate the survey in the context it is being used in, blue-collar workers in Lebanon.

The background section in the survey helped in describing the demographics of the respondents. The results are summarized in Table 3. Figure 4 also shows the frequency results per worker characteristic.

Table 3: Demographic Information of Respondents

Variable	Category	Number of cases	Frequency (%)
Age	16-25	52	37.96
	26-35	49	35.77
	36-45	27	19.71
	46-55	8	5.84
	56+	1	0.73
Experience	0-4	43	31.39
	5-9	41	29.93
	10-14	26	18.98
	15-19	7	5.11
	20-24	8	5.84
	25-29	5	3.65
	30+	7	5.11
Education	Not educated	11	8.03
	Elementary	45	32.85
	Middle	14	10.22
	Secondary	40	29.20
	Technical	14	10.22
	Bachelors	13	9.49
Position	Unskilled Worker	69	50.36
	Skilled Worker	50	36.50
	Foreman	18	13.14





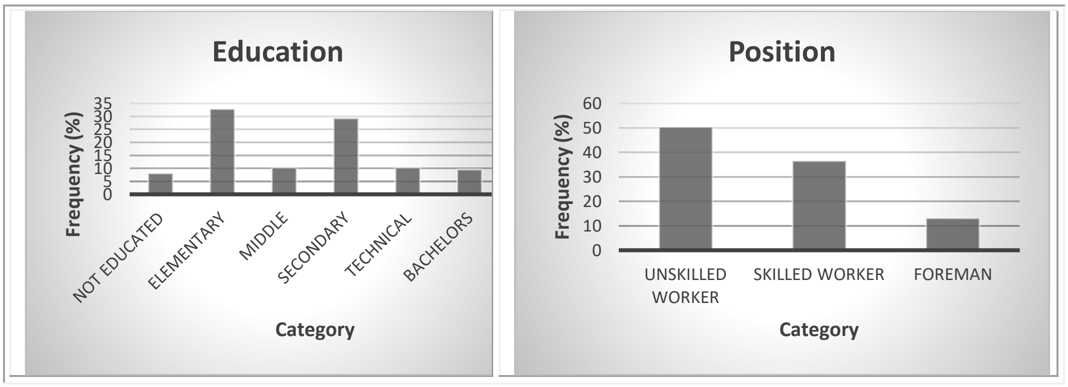


Figure 4: Frequency results per worker's characteristic

Many respondents (37.96 percent) are in the youngest age range (16-25 years) and thus most of them have the least experience (31.39 percent). Unlike in North America, where the average age for construction workers is 41 (Davis 2017). Similarly, in United Kingdom it is 45 and in China it is 40 (Coates 2018; Zhao 2018).

It is important to note that more than 50 percent of the respondents did not finish school, which is a characteristic of the construction workforce in the MENA region. Unlike in the US where only 20 percent of the construction workforce is not educated (Center 2010). The majority of workers in the MENA region receive no formal training and join construction sites once they are of a working age (Kiomjian et al. 2016). This increases the chance of occupying the unskilled or junior position (50.36 percent).

4.2 Statistical Analysis

This section presents the strategy for modeling the collected data for conducting statistical analysis, as summarized in Figure 5. It is inclusive of all objectives, assumptions, and decisions based on the analysis methods chosen as well as results for the critical steps. It is also supported by theoretical background from seminal works, most of which are by Hair et al. (1998) unless otherwise stated. It starts by highlighting the main steps of SEM then goes into the steps of factor analysis and path analysis which are embedded in SEM analysis.

SEM can test the hypothesized multiple causal relationships since it is able to show the relationships between each factor identified as construct/ latent variable and its corresponding indicator as well as being efficient for a series of multiple-regression equations to be estimated simultaneously (Fang et al. (2015); Hair et al. (1998)). It is a two-step modeling method that integrates factor analysis and path analysis (Hair et al. 1998), to show hypothesized relationships between latent variables and their indicators and the links between the independent and dependent latent variables respectively (Hair et al. 1998). Statistical Package for Social Sciences (SPSS) and Analysis of moment structures (Amos) are the software employed for such modeling and analysis (Arbuckle 2006).

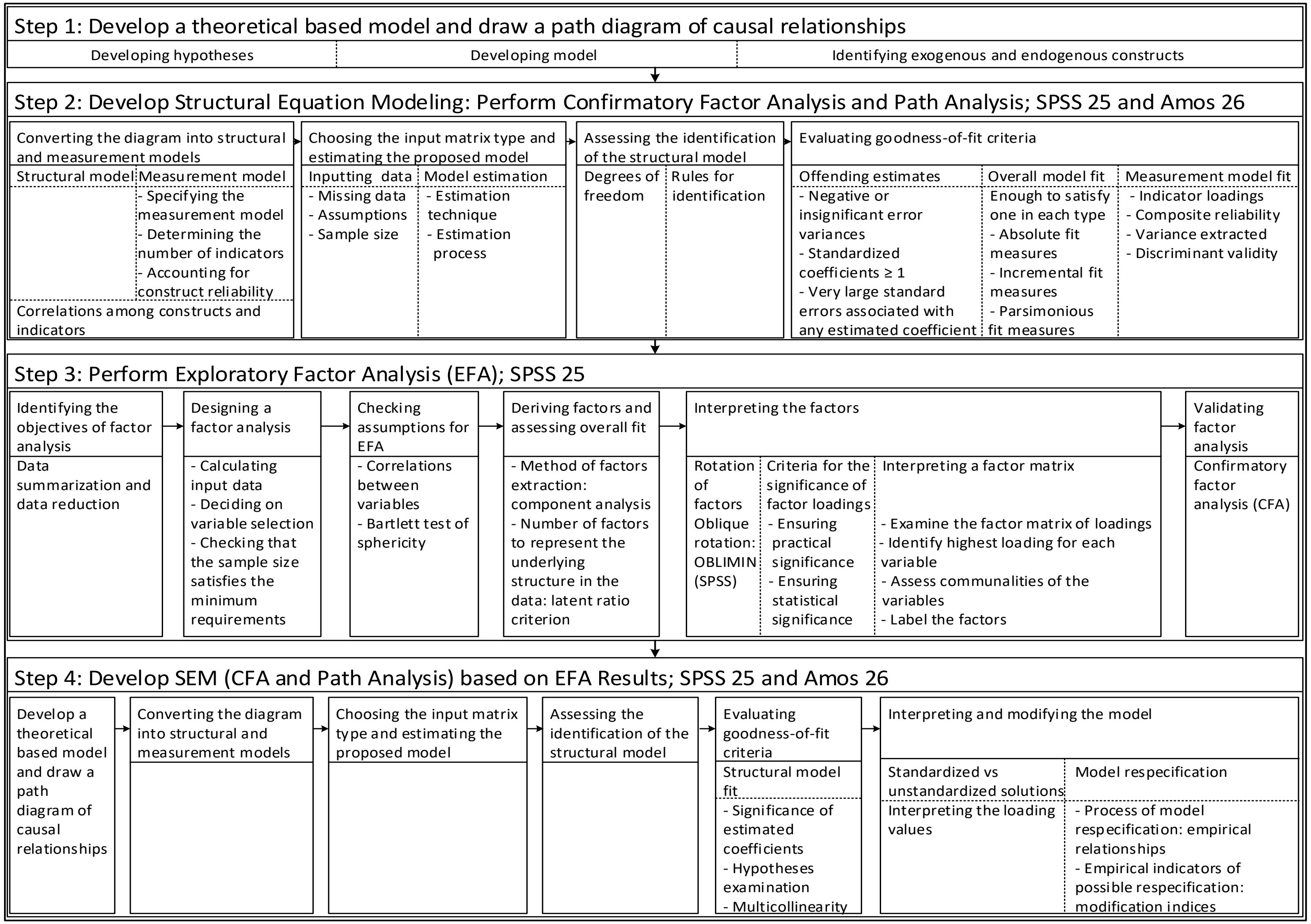


Figure 5. Modeling strategy step

4.2.1 *Step 1: Develop a Theoretical Based Model and Draw a Path Diagram of Causal Relationships*

The theoretical based model was developed in Chapter 3. The hypotheses were based on theoretical background, and the path diagram of causal relationships was drawn.

Relying on these hypotheses, the exogenous and the endogenous constructs are defined from the set of chosen variables. Exogenous constructs are the independent or source variables while endogenous constructs are the dependent or response variables that are predicted by other constructs. Table 4 shows these constructs.

Table 4: Endogenous and Exogenous Constructs

Endogenous construct	Exogenous construct
Affiliation	Fairness
Sense of self-worth	Anticipated reciprocal relationship
Subjective norm	
Attitude	
Intention	

In this step, the aggregation of items (questions) under a certain construct is adopted from the seminal work of Bock et al. (2005). Accordingly, a confirmatory factor analysis (CFA) will take place to confirm that the suggested allocation of items is functional in the context under study.

4.2.2 *Step 2: Perform CFA and Path Analysis*

SEM is a popular mode of analysis used in analyzing survey results that are based on hypothesized models. It is a hybrid model of two components: measurement model and structural model. Where the measurement model is tested by confirmatory factor analysis and the structural model is measured by path analysis (Kline 2015). The measurement model shows the hypothesized relationships between latent variables and their indicators as shown in Figure 3 while the structural model links the independent and dependent latent variables as shown in Figure 2. This integration of analysis is only done by SEM which renders it preferable over multiple regression analysis due to its advantages. It can show the relationship between each indicator and its corresponding latent variable, and it is efficient in simultaneously estimating a series of multiple regression equations.

SPSS 25 and Amos 26 will be used in this study to carry on with Kline (2015) two-step modeling method of CFA, to test for the measurement model, and path analysis, to test for the structural model. A summary of the expected outcomes and results to be checked in this two-step modeling is shown in Figure 6.

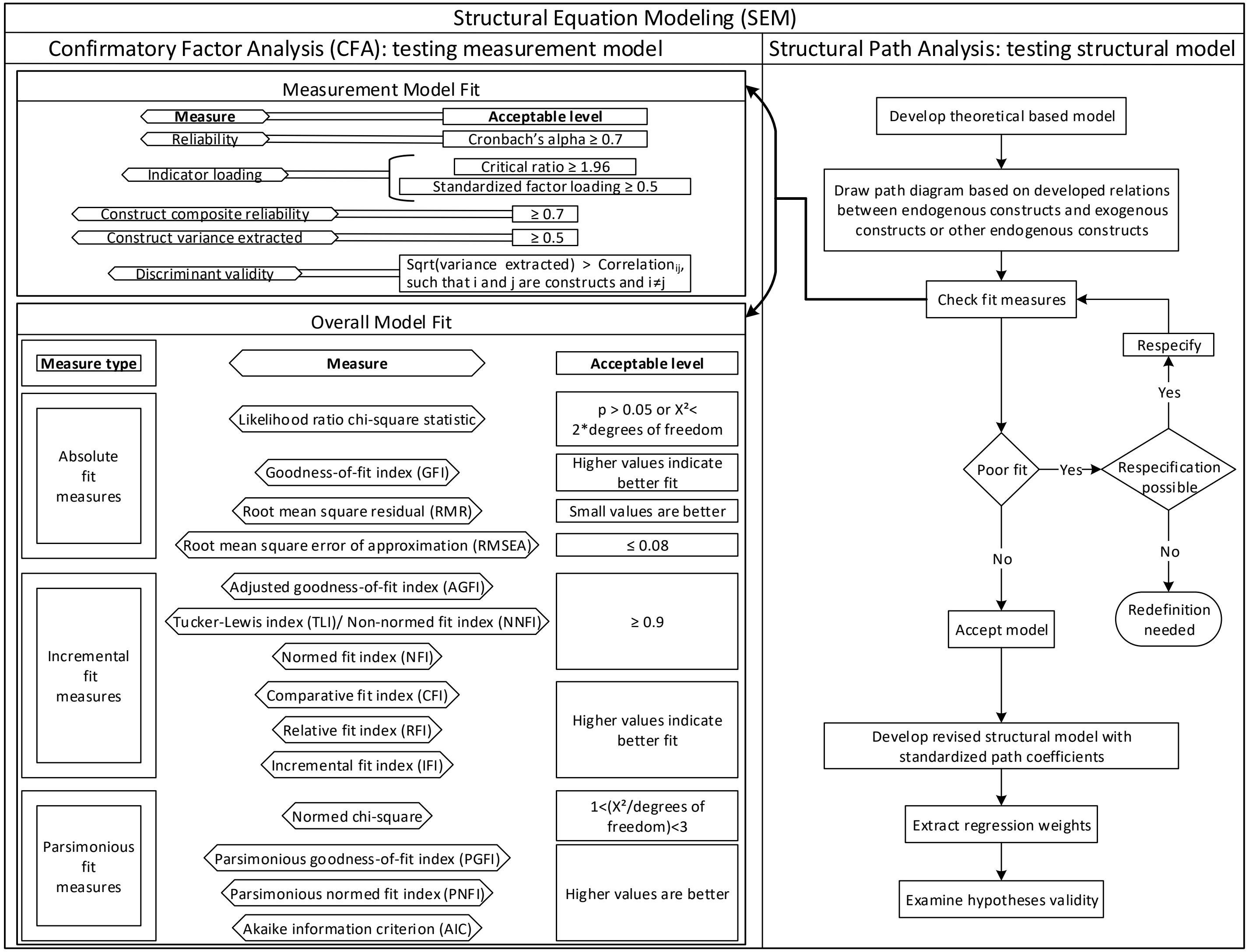


Figure 6. SEM: model fit criteria and expected results

4.2.2.1 Converting the diagram into structural and measurement models

4.2.2.1.1 Structural model:

The path diagram gets translated to a structural model which is a set of structural equations. These equations are developed when the endogenous constructs are examined to see their relationships with exogenous constructs and other endogenous constructs. For each hypothesized relationship, a structural coefficient will be estimated. A snapshot of the first structural model developed in this study is available in Appendix D.

4.2.2.1.2 Measurement model:

Measurement model is developed by checking the number of indicators per construct and specifying the reliability of the construct.

Specifying the measurement model:

If the researcher specified which variable defines which construct (factor), this is termed as confirmatory factor analysis. The variable will be termed as "indicator" since it is used to measure the latent variable. This is the case in this study. In the measurement model, the researcher has full control over which variable defines which construct. The measurement model is specified in the same manner for both exogenous and endogenous constructs.

Determining the number of indicators:

The preferred minimum number of indicators per construct is three and there is no maximum number of indicators if the choice of indicators is supported by theory. In this study, the minimum number of indicators per construct is three.

Accounting for construct reliability:

The research team decided to use empirical estimation as the method to establish reliability. The constraint for this method is for the construct to have two or more indicators. After estimating the structural and measurement models, the loading coefficients will be examined to check reliability for indicators and the overall construct. The detailed methodology for this approach is described in step 2.4.

4.2.2.1.3 Correlations among constructs and indicators:

There are relations to be specified by the research team between exogenous constructs or between endogenous constructs, other than the structural and measurement models. This is because exogenous constructs can be related and thus have a shared effect on the endogenous constructs. Correlations among endogenous constructs are not recommended since they represent correlations among the structural equations that misperceive their interpretation. Also, it is better to avoid correlating the indicators in the measurement model separately from the construct correlation. The choice of correlations between the exogenous variables is supported by literature. Based on that, correlation between "fairness" and "anticipated reciprocal relationships" was incorporated. According to Holste and Fields (2010), personal relationships between coworkers are based on the ability to develop trust. This trust reflects on the worker's view of the level of fairness practiced by the organization. On the other hand, personal relationships are developed through the communication process that takes place between these workers which represents their view to anticipated reciprocal relationships. Hence, there is a correlation between fairness and anticipated reciprocal relationships.

4.2.2.2 Choosing the input matrix type and estimating the proposed model

4.2.2.2.1 Inputting data:

The respondents' records must be first entered to SPSS. SEM is a multivariate technique that uses as input the variance-covariance or correlation matrix extracted from SPSS into Amos. Since the focus of SEM is on the pattern of relationships among respondents and not on individual observations, the measurement model will use the input matrix to specify how indicators belong to the constructs and the structural model shows the latent construct scores.

Missing data:

Any record with missing data or inconsistent data is suspicious and might cause bias in the analysis. Thus, these records were removed by the research team before entering the data into SPSS. They account for a total of 34 records.

Assumptions:

Three assumptions must be satisfied to perform multivariate analysis, such as SEM, and they are independent observations, random sampling of respondents, and the linearity of all relationships (Hair et al. 1998). All three are satisfied in this study. Nevertheless, SEM is more sensitive to distribution characteristics than any other multivariate method. Thus, the two most important properties to consider are multivariate normality and kurtosis (skewness) of the data. Hence, diagnostic tests should be performed on the data before deciding on the estimation method.

However, outliers must be detected first and removed from the dataset. In this step, the boxplot for each construct was used to highlight and remove the outliers in SPSS. Hence the number of records decreased from 137 to 123.

Sample size:

In SEM there is no one right way of determining the sample size; however, as indicated by Hair et al. (1998) a sample size ranging between 100 and 200 would be enough. This is echoed by the work of Boomsma (1983) and Sideridis et al. (2014) who argue for a similar sample size for a power of 80% and a ratio of number of measured variables to number of latent factors. In this study, 171 respondents were interviewed out of which 137 were identified as usable responses. After checking for outliers, 123 responses were left to perform SEM.

4.2.2.2.2 Model estimation:

After specifying the structural and measurement models and choosing how to input the data, the researcher will choose which estimation method to use.

Estimation technique:

Maximum likelihood estimation (MLE) is used when the multivariate normality assumption holds true. The researcher will perform normality test to check for this assumption and for any outliers causing non-normality.

After inputting the data in Amos, tests for normality and outliers are performed. According to Kline (2011) examining the critical ratio for skewness and kurtosis may cause rejection of the model, due to large sample size, while it is acceptable. Thus, Kline (2011) suggested that to satisfy univariate normality for each indicator, the kurtosis value must be less than 8 and the absolute value for skewness must be less than 3 (Kline 2011). However, for the multivariate value, according to Bentler (2007), a value less than 5 indicates satisfaction of multivariate normality. In case there is a need to identify outliers, Mahalanobis method is used, and it relies on having a large gap in the value between the records (Tabachnick et al. 2007). Hence, a different estimation technique or an additional estimation process is applied to ensure that SEM is performed in a fashion that suits the distribution of the data.

Estimation process:

To solve the problem of non-normality to allow using the maximum likelihood estimation technique, bootstrapping is a popular estimation process option (Pek et al. 2018). In this process parameter estimations are calculated by Amos based on multiple estimations. Basically, the original sample is resampled (500 times) with 95% confidence level to generate new samples which have their parameters estimated, and these estimates are averaged across all samples to find the final estimates of the parameters. However, it is not always enough to perform only bootstrapping but might also need to perform Bollen-Stine bootstrap to improve the chi-squared value to be within the chi-squared distribution.

4.2.2.3 Assessing the identification of the structural model

It is important to do not have problems with identification since otherwise the model will not be able to generate unique estimates.

4.2.2.3.1 Degrees of freedom:

The degrees of freedom value is determined by the size of the covariance matrix. The number of degrees of freedom is the difference between the number of correlations and the actual number of coefficients in the proposed model:

$df = \frac{1}{2}[(p+q)(p+q+1)] - t$ (Equation 1)

Where p= number of endogenous indicators, q= number of exogenous indicators, and t= number of estimated coefficients in the proposed model. The first part of the equation calculates the non-redundant size of the correlation matrix which is the lower or upper half of the matrix plus the diagonal. Thus,

$$\frac{1}{2}[(p+q)(p+q+1)] =$$

$$\frac{1}{2}[(number\ of\ measured\ variables)(number\ of\ measured\ variables+1)]$$ (Equation 2)

The number of measured variables is 28, hence the size of the correlation matrix is 406. As for the estimated coefficients in the model, they are inclusive of the 30 unlabeled weights (labeled weights are those items fixed to 1), 1 covariance (for the correlation imposed earlier), and the 35 variances (28 errors, 5 residuals, and 2 independent variables) adding up for a total of 66. Thus, there are 340 degrees of freedom.

4.2.2.3.2 Rules for identification:

One rule to establish the identification of a model is the order condition that states that a model with degrees of freedom greater than zero is termed as an over-identified model, which is needed for SEM. This type of model has more information in the data matrix than the numbers of parameters to be estimated. In this study the number of degrees of freedom is surely greater than zero. To ensure a generalizable model, the researcher wants to achieve acceptable fit with the largest number of degrees of freedom. It is not enough to only satisfy the order condition rule for identification, but the researcher also needs to satisfy the rank condition rule. This rule states that the researcher must check if each parameter is uniquely identified. This is done first by checking for the three-measure rule which states that each construct with three or more indicators is always identified. Second, the recursive model rule must be met which states that a recursive model with identified constructs is always identified. In this study, both rules are met since each construct is measured by at least three indicators (questions), and the model is recursive where recursive means that the paths go only in one direction.

4.2.2.4 Evaluating goodness-of-fit criteria

First the offending estimates must be checked and once the model is identified as providing acceptable estimates, the goodness-of-fit of the model is checked on two levels: the overall model and then the measurement and structural models.

4.2.2.4.1 Offending estimates:

Offending estimates are estimated coefficients in the measurement or structural model that exceed acceptable limits and they come in three different forms. The first is negative error variances or nonsignificant error variances for any construct. The second is standardized coefficients exceeding or very close to one. The third is very large standard errors associated with any estimated coefficient.

In this study offending estimates were checked at every run. The results showed that there are no problems with the first two criterion; however, the third had a couple of large standard errors. In that case, the researcher had to deal with them by model respecification which is properly explained and done upon further model fit results.

4.2.2.4.2 Overall model fit:

One or two goodness-of-fit measures are enough to assess the overall model fit. The goodness-of-fit measures show how much the matrix predicted from the proposed model corresponds to the actual input (covariance or correlation) matrix. One overall model fit requirement is achieving parsimony which means having a larger number of degrees of freedom and thus achieving better model fit for each estimated coefficient. The fewer coefficients needed to achieve a better fit, the more confident the researcher is that the model is not overfitting the data. In CFA the overall model fit indicates the degree to which the specified indicators represent the hypothesized constructs.

Goodness-of-fit measures are divided into three categories. Absolute fit measures are the first and it assesses the overall model combining the measurement and structural models without making any adjustment for the possibility of overfitting the model. The second is incremental fit measures that works as a comparison tool between the proposed model and its variants developed by the software. The third is parsimonious fit measures that also works as a comparison tool between models with differing numbers of estimated coefficients but first by adjusting the fit measures for this purpose. This is done to find how much each estimated coefficient can fit. To assess the goodness-of-fit, the researcher can use one or more measures from each type. Using several measures to assess this fit will allow the researcher to gain more confidence on the acceptability of the proposed model across several types of measures. Acceptable fit levels are shown in the table in Appendix E.

The researcher must further assess the fit of the measurement model and the status of the structural model regardless that the overall model fit is acceptable since it does not guarantee their results. Assessing measurement model fit and structural model fit would also help in identifying what problems affected the overall model fit.

For the purpose of demonstration, the results of this section are shown for the first, second, and last runs of this model, upon the respecification steps done (Appendix F).

Upon comparison with the acceptable levels of fit for each measure, the results for all the runs show that there is some improvement in the model fit upon respecification but still did not reach satisfactory levels for at least one measure in each category.

4.2.2.4.3 Measurement model fit:

Reliability must be checked for the measurement of each construct. Reliability is “the degree to which a set of latent construct indicators are consistent in their measurements”. Highly inter-correlated indicators explain highly reliable construct indicating that they are measuring the same latent construct. A reliability measure such as Cronbach’s alpha is used to check reliability.

Each construct is now evaluated separately by first examining the estimated factor loadings and assessing their statistical significance. If any indicator does not meet statistical significance, the researcher can eliminate this indicator from the model or transform it for a better fit with the construct. Second, it is evaluated by assessing the construct’s reliability and variance extracted.

The values obtained upon calculations as indicated in the following sub-sections are provided in appendix F.

Indicator loadings:

The t values associated with each of the loadings for each variable should be greater than the critical ratio value associated with the significance level chosen. In this study the significance level is 0.05 hence the CR value is 1.96. According to Hair et al. (1998), for 80% power and significance of 0.05, and according to the sample size at hand (123), a factor loading of 0.5 is adopted.

Composite reliability:

Reliability is defined as a measure of the internal consistency of the construct indicators. It shows to which level the indicators can "indicate" the common latent unobserved construct. The more the measures are reliable, the higher is the researcher's confidence that the individual indicators are consistent in their measurements. The reliability of each construct is assessed by calculating the composite reliability and insuring an acceptable value of 0.7 and above.

Equation 3 is used to calculate the composite reliability for each multiple indicator construct:

$$Construct\ reliability = \frac{(\sum standardized\ loading)^2}{(\sum standardized\ loading)^2 + \sum \varepsilon_j} \text{ (Equation 3)}$$

The standardized loadings are the factor loadings obtained from Amos output and ε_j is the measurement error for each indicator. It is calculated as shown in equation 4.

$$\varepsilon_j = 1 - reliability_j = 1 - (standardized\ loading_j)^2 \text{ (Equation 4)}$$

The indicator's reliability should be greater than 0.5 thus corresponding to a standardized loading of 0.7 and above.

Variance extracted:

It is another measure of reliability that "reflects the overall amount of variance in the indicators accounted for by the latent construct". Higher variance extracted values reflects that the indicators truly represent the latent construct. Variance extracted reflect on convergent validity (Alumran et al. 2014). Equation 5 is used to calculate variance extracted measure for each construct:

$$Variance\ extracted = \frac{\sum(standardized\ loading)^2}{\sum(standardized\ loading)^2 + \sum \varepsilon_j} \text{ (Equation 5)}$$

The variance extracted value should be greater than 0.5 for each construct. However, it is important to differentiate between reliability and validity. The latter is "the extent to which indicators accurately measure what they are supposed to measure". The measures might be reliable but not valid since they don't represent the right construct. Validity is determined by how the researcher chooses the indicators for a latent construct.

Discriminant validity is ensured once the square root of the average variance extracted for each construct is greater than the levels of correlations involving the construct (Chin et al. 1997).

There are further steps to be performed in an SEM (CFA) approach; however, they are not presented in this section since they weren't performed by the research team due to the results at hand.

In this study, confirmatory type of factor analysis was approached first based on theory as per the seminal work of Bock et al. (2005); however, the model failed in structure due to the context of application. These differences are associated with two main roots; the specificities of the construction industry at the level of the front-line workers and the cultural differences between the national contexts of previous works and the Lebanese/ MENA region. For example, the construction workers in the MENA region are paid by the hour, have no vocational training, and most of them lack enough education (Srour et al. 2017). Another example is the transient nature in the construction industry where workers do not get the chance to build social ties with their colleagues and have the chance to feel the need for sharing knowledge that is necessary for future work progress (Srour et al. 2017). Also, upon data collection many workers have noted that they are forced to work as a single unit to get the job done but they do not believe that at the personal level. For example, a general foreman stated, “we work as a team very well to get the work done in the most efficient way and hence get paid; however, on the personal level the workers don’t care to know each other or have any kind of social connections”.

Due to such incompatibility in the model, the collected data were analyzed by first utilizing another factor analysis approach before carrying on with SEM.

4.2.3 *Step 3: Perform Exploratory Factor Analysis (EFA)*

“Factor analysis addresses the problem of analyzing the structure of the interrelationships (correlations) among a large number of variables by defining a set of common underlying dimensions known as factors”. It is a multivariate technique. By using such a technique, the researcher is identifying the separate dimensions of the structure and then determining the degree to which each variable is explained by each dimension. Hence achieving the main objectives of factor analysis which are summarization and data reduction. Summarization is deriving underlying dimensions that describe the data in a smaller number of concepts than the individual variables once understood. Data reduction is using the calculated scores for each dimension as a substitute for the original variables.

Factor analysis is an interdependent technique where one or more variables are explicitly considered the criterion or dependent variables and all others are predicted or independent variables. The variates (factors) are not designed to predict a dependent variable but to explain the entire variable set as much as possible. It is an interdependent technique since it aims at structure identification rather than prediction like in dependence techniques.

There are two perspectives of factor analysis: the exploratory and the confirmatory. The exploratory is searching for a structure among a set of variables which satisfies the data reduction objective. In this method, there are no previous constraints on the estimation of components rather they are determined by what the data give. Had the researcher have previous knowledge from theory on the structure of the data, she will be applying the confirmatory perspective of the factor analysis. In confirmatory approach, the researcher is assessing the extent to which the data meet the expected structure.

Once the model fails under CFA, an EFA is suggested to take place to rearrange the items on the constructs where they are loading the most. The following are the steps carried on in this study to perform EFA. Most of the results shown are those of the last run; however, the results of the previous runs are explained or referred to upon need.

4.2.3.1 Identifying the objectives of factor analysis

Factor analysis aims at either identifying the structure through data summarization or data reduction. The former can be done by examining either the correlations between variables or the correlations between the respondents. Correlations between the variables is the most used since the researcher's objective is to summarize the characteristics. This is done through R factor analysis that analyzes set of variables to identify the latent (not easily observed) variables. As for data reduction, it aims at either identifying several variables from a larger set or creating new set of variables to replace original variables. In both cases, the nature and character of the original variables are reserved. The contributions of each variable to the factors (termed loadings) are used in the data summarization analysis. These loadings are also used in data reduction to identify variables for analysis with other techniques. They can also be used to make estimates of the factors themselves to replace the original variables in the following analyses. After identifying the objectives, the researcher must decide which variables are to be examined. The potential dimensions are implicitly specified through the nature and character of the variables submitted. For example, to be able to operate factor analysis for the dimension "fairness", there need to be question on how the boss treats the crew members. For data summarization, there is no need for any conceptual basis; however, for data reduction, factor analysis is most efficient when the derived factors represent conceptually defined dimensions.

4.2.3.2 Designing a factor analysis

Designing a factor analysis involves three steps. Considering that the objective was identified as grouping of variables, the first step would be calculating the input data (correlation matrix between the variables) for the R-type factor analysis. The second step would be deciding on variable selection for the number, measurement properties, and types. It is important to have a reasonable number of variables per factor. It is important to identify key variables that identify the hypothesized underlying factors. The variables are of ordinal type since they follow the Likert scale. The third step would be checking that the sample size satisfies the minimum requirements. A general requirement is to have observations as five times the variables to be analyzed with a minimum of 100 observations. In this study, there are 28 variables, hence 140 observations are required. In this study, 25 of the items are to be distributed among components while the last three that pertain to intention are not to be included. This is because it is the section to be measured in later steps. The original collected observations are 171. The usable number of records is 137, and it will be used in the steps that follow.

4.2.3.3 Checking assumptions for EFA

To justify the use of factor analysis, the researcher must refer to the data matrix to ensure there are enough correlations. There should be a considerable number of correlations between the variables, higher than 0.3. Using SPSS, the correlations matrix was examined for significant correlation values greater than 0.3.

Another statistical mode for determining the appropriateness of performing factor analysis is doing the Bartlett test of sphericity. It is a statistical test for the presence of correlations among variables. It shows the probability that the correlation matrix has significant correlations among at least some of the variables. The p-value for Bartlett's test of sphericity should be less than 0.05 indicating that the variables are related. The KMO value is recommended to be the closest to 1 (Center). Based on the results of the tests, both indicators suggest that factor analysis is doable. The p-value of the Bartlett's test was found to be 0 indicating that the variables are related and KMO value tests for the adequacy of the variables was found to be 0.831 (closest to 1) (Center ; George and Mallery 2016).

4.2.3.4 Deriving factors and assessing overall fit

Since the variables are specified and the correlation matrix is ready, the researcher can proceed with factor analysis to identify the underlying structure of the relationships. The researcher must decide on first, the method of factors extraction, and second, the numbers of factors selected to represent the underlying structure in the data.

Method of factors extraction could be either common factor analysis or component analysis. This method is determined based on the researcher's objective identified earlier and the level of prior knowledge about the variance of the variables. The former is used to identify underlying dimensions that reflect what the variables share. The latter is used for prediction purposes by summarizing the original information (variance) in a minimum number of factors. Three types of variances exist in factor analysis. The common variance which is shared with all variables in the analysis. Specific variance which belongs to only one variable. Error variance due to the unreliability in the data-gathering process, measurement error, or random component in the measured phenomenon. Component analysis uses the total variance and extracts from it factors that contain unique variances and error variances. Unities are inserted into the diagonal of the correlation matrix to result in full variance in the factor matrix. As for common factor analysis, estimates of the common variance among the variables referred to as communalities are inserted in the diagonal. Hence, the resulting factors are based only on common variance (Hair et al. 1998).

Considering the objective of the study and after satisfying the assumptions (statistics), component analysis is used. Principal component analysis (PCA) assumes that there is no unique variance and that total variance is attributed only to the common variance. PCA aims at using a smaller number of components and linear combinations than the original number of items to replicate the correlation matrix. Initially, a certain number of extracted factors is used based on theoretical background (Bock et al. 2005) to be able to decide on the exact number of factors to extract. All the measured items are chosen for this analysis except for those measuring intention. Hence, there are 25 measured items with seven factors to be extracted. The most used technique in determining the number of factors extracted is the latent ratio criterion which is applied by examining the Eigenvalues. The factors having an Eigenvalue greater than 1 are considered significant. All factors with Eigenvalues less than 1 are insignificant and disregarded. It is the most reliable criterion when the number of items is between 20 and 540. In this study, there are 25 items. Thus, the final model extracts five components, of Eigenvalues larger than 1, expected to be affecting knowledge sharing intentions of construction workers accounting for 63.5% of the total variance explained. Another criterion that can be checked is the Scree test criterion which works by identifying the number of factors just before where the amount of unique variance starts to dominate the common variance structure. The shape of the resulting curve of the number of factors against the latent roots is used to determine the cutoff value. This test generally gives one or two more factors than the latent root criterion (Consulting). The point where the slope stops changing determines the number of components to be extracted which is at component seven in the same range as the previous test (as shown in Figure 7).

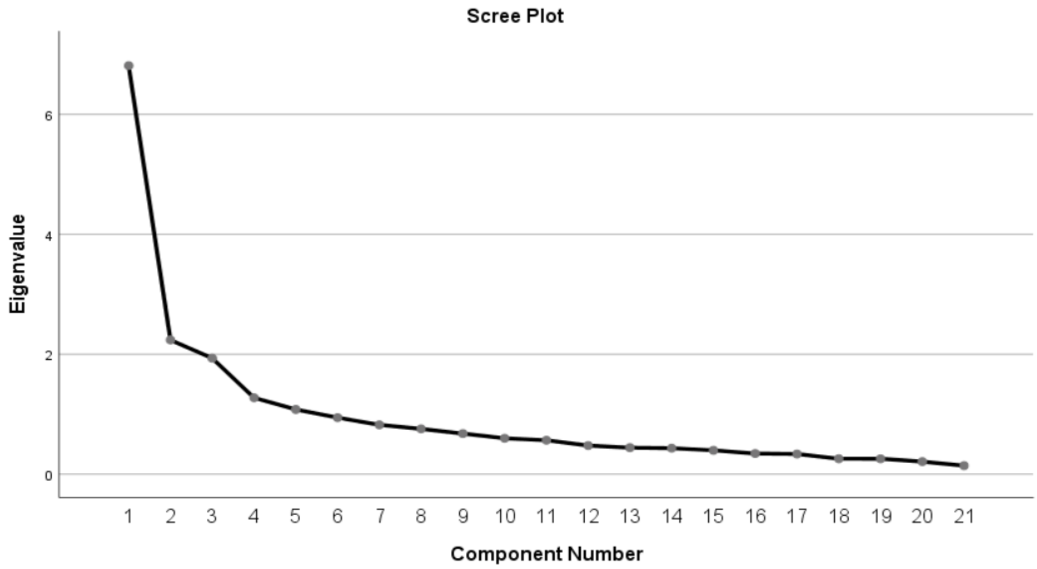


Figure 7: Scree plot

4.2.3.5 Interpreting the factors

Initially unrotated factor matrix is obtained to have a preliminary indication of the number of factors to extract. But unrotated factor solutions might not always deliver the best interpretation of the variables. Hence, a rotation of the factors is needed to achieve simpler and more meaningful factor solutions. Later the researcher must assess the need to respecify the factor model.

4.2.3.5.1 Rotation of factors:

Unrotated factor solutions tend to extract factors in the order of importance where the first factor is the general one such that almost every variable load on it significantly. The other factors are based on the residual amount of variance where each account for smaller amount of variance successively. Hence, by using a rotation these variances are redistributed from earlier to later factors obtaining a theoretically more meaningful factor pattern.

There are two types of rotation either orthogonal or oblique. Oblique rotational method is more flexible and more realistic since theoretically important underlying dimensions are not assumed to be uncorrelated with each other. On the other hand, orthogonal rotations are widely used since they are available in most computer packages. Oblique rotations are like orthogonal rotations, but they allow correlated factors instead to maintain independence between the rotated factors which serve in the interest of this study. In SPSS, OBLIMIN is the oblique rotation approach available and is used in this study. There is no compelling analytical reason for the choice of rotation method, but it depends on the problem itself and the aim of the researcher. If the researcher cares about reducing the number of original variables, orthogonal rotation will be chosen. However, if the researcher cares about obtaining theoretically meaningful factors, oblique rotation is chosen. This is the case in this study where the research team used an adequate rotation method (oblique- OBLIMIN) of the components to redistribute variances and obtain theoretically more meaningful factor pattern (Hair et al. 1998).

4.2.3.5.2 Criteria for the significance of factor loadings:

Practical and statistical significance of the factor loadings are assessed to determine which factor loadings are worth keeping in the study. Another criterion is used which is considering the number of variables in the study.

Ensuring practical significance:

The factor matrix is examined for factor loadings to be greater than +-0.3 to have a minimal level of acceptance, loadings greater than +-0.4 are more important, and those greater than +-0.5 are practically significant. The loading values translate into the percentage of variance explained by each factor because “the factor loading is the correlation of the variable and the factor; the squared loading is the amount of the variable’s total variance accounted for by the factor”. So, a loading of 0.7 accounts for 50% of the variance. This test is applicable for sample sizes of 100 and above. So, it applies in this study. As shown in Figure 8, all variables of the last run have an absolute value of factor loading greater than 0.5 indicating that they are practically significant.

Pattern Matrix[a]

	Component				
	1	2	3	4	5
My knowledge sharing would strengthen the ties between project members and myself	.882	-.061	.015	.080	.133
My knowledge sharing would get me well-acquainted with new project members	.704	-.042	-.127	-.085	.023
My knowledge sharing would expand the scope of my association with other project members	.705	-.120	-.104	-.064	-.240
My knowledge sharing would draw smooth cooperation from outstanding project members in the future	.803	.054	.128	.056	-.081
My knowledge sharing would help other project members solve problems	.533	.089	-.182	.055	-.160
My knowledge sharing would improve work processes in the project	.481	.156	-.522	-.033	.043
My knowledge sharing would increase productivity in the project	.386	-.015	-.510	-.172	-.229
My knowledge sharing would help the project achieve its performance objectives	.285	.072	-.650	-.205	-.066
Members in my team keep close ties with each other	.028	.128	-.570	.060	-.392
Members in my team consider other members' standpoint highly	.027	-.007	-.371	.101	-.677
Members in my team have a strong feeling of unity	-.012	.067	.063	.000	-.870
Members in my team cooperate well with each other	.152	.029	.035	-.143	-.730
I can trust my boss's evaluation to be good	.114	.752	.016	.148	.021
Tasks which are given to me are reasonable	-.200	.579	-.257	.022	-.215
My boss doesn't show favoritism to any one	-.009	.605	.068	.343	-.226
My knowledge sharing with other project members is good	.016	.586	-.211	-.225	.093
harmful question_Att2_end_ReverseCoded	-.116	-.206	-.158	-.620	-.147
My knowledge sharing with other project members is an enjoyable experience	.350	.181	.341	-.461	-.326
My knowledge sharing with other project members is valuable to me	.359	.210	.313	-.492	-.254
My knowledge sharing with other project members is a wise move	.061	.239	.023	-.793	.151
My boss thinks that I should share my knowledge with other members in the project	-.041	.694	.170	-.268	-.027

Extraction Method: Principal Component Analysis.
Rotation Method: Oblimin with Kaiser Normalization.

a. Rotation converged in 46 iterations.

Figure 8: Pattern matrix

Assessing statistical significance:

It is suggested to employ the concept of statistical power and differing sample sizes to assess statistical significance of factor loadings. Thus, considering a power level of 80%, 0.05 significance level, and the proposed inflation of standard errors of factor loadings, the acceptable factor loading cutoff is determined. So, considering a sample size of 137 which is greater than 120, a factor loading of 0.5 and above is considered significant. Using the cut-off value of 0.5 for significance, all variables are considered statistically significant (Figure 8).

4.2.3.5.3 Interpreting a factor matrix:

Examine the factor matrix of loadings:

The factors are represented by columns with numbers as headings while the variables are those on the rows. In an oblique rotation, the output consists of two matrices: the factor pattern matrix and the factor structure matrix. The former has loadings that represent the unique contribution of each variable to the factor. The latter has simple correlations between variables and factors, but these loadings contain the unique variance between variables and factors and the correlation among factors. Usually researchers report the results of the pattern matrix.

Identify the highest loading for each variable:

The researcher must look for the highest loading of each variable. This happens by examining each variable horizontally among all the components (columns) to find the highest absolute value. This highest absolute factor loading is the significant one. If there are several loadings of the same significance, then the item is subject for deletion since the idea is to minimize the number of significant loadings on each row of the factor matrix. Table 5 shows the factor loadings and components results of the 25 variables reduced to 21 variables and categorized in five components.

Table 5: Results of EFA and Cronbach's Alpha for Factors Affecting Knowledge Sharing Intentions

Factor Loading					
Component / Item	Component 1	Component 2	Component 3	Component 4	Component 5
ARR1	**0.882**	-0.061	0.015	0.080	0.133
ARR2	**0.704**	-0.042	-0.127	-0.085	0.023
ARR3	**0.705**	-0.120	-0.104	-0.064	-0.240
ARR4	**0.803**	0.054	0.128	0.056	-0.081
SSW1	**0.533**	0.089	-0.182	0.055	-0.160
Fair1	0.114	**0.752**	0.016	0.148	0.021
Fair2	-0.200	**0.579**	-0.257	0.022	-0.215
Fair3	-0.009	**0.605**	0.068	0.343	-0.226
Att1	0.016	**0.586**	-0.211	-0.225	0.093
SN1	-0.041	**0.694**	0.170	-0.268	-0.027
SSW2	0.481	0.156	**-0.522**	-0.033	0.043
SSW3	0.386	-0.015	**-0.510**	-0.172	-0.229
SSW4	0.285	0.072	**-0.650**	-0.205	-0.066
Aff1	0.028	0.128	**-0.570**	0.060	-0.392
Att2	-0.116	-0.206	-0.158	**-0.620**	-0.147
Att3	0.350	0.181	0.341	**-0.461**	-0.326
Att4	0.359	0.210	0.313	**-0.492**	-0.254
Att5	0.061	0.239	0.023	**-0.793**	0.151
Aff2	0.027	-0.007	-0.371	0.101	**-0.677**
Aff3	-0.012	0.067	0.063	0.000	**-0.870**
Aff4	0.152	0.029	0.035	-0.143	**-0.730**

Assess communalities of the variables:

After identifying the factor loadings, the researcher must check the matrix to identify the variables that do not load on any factor. Then the researcher should examine the communalities of the variables to assess if they meet acceptable levels of explanation since the communality represents the amount of variance accounted for by the factor solution for each variable. The research team decides on the amount of variance to be considered; hence, deciding on the acceptable level of communality value associated with it. After choosing a threshold for communality, there are two modes of work for variables that do not load on any factor or that have low communality values: either interpreting the solution at hand by ignoring those variables or evaluating each of those variables for deletion. Deletion of any variable depends on the objective of the study and whether the variable is of importance. If deletion takes place, model respecification is applied and the variables are to load again on different factors. The research team decided on a communality threshold of 0.5; hence, explaining half of the variance. The results of communality values indicate that there are no values below 0.5 for any item to be removed.

Label the factors:

After achieving a significant factor loading matrix, the researcher starts to assign some meaning to the pattern of factor loadings that arose. In each pattern the variables with larger loadings are considered more when assigning a name for the factor. As for the signs of the loadings, like signs mean that these variables are positively related and unlike signs mean that these variables are negatively related. If at some point a factor cannot be given a label, then it is termed as “undefined”. Hence, the researcher interprets the defined factors in the model since they have meaningful relationships but still mentions that there are some undefined factors.

Considering the components results of the first model as shown in Appendix G, there are several decisions to be made based on interpretation before moving to the next step. There are three undefined components: F4, F5, and F7. This is because theoretically and logically speaking, the variables are not quite measuring a unified and well-defined construct. Another consideration is the required minimum number of factors per construct to be able to perform validation of the factor analysis. In reference to sub-step 3.6, validation happens through CFA and in CFA the reasonable number of items in a construct is three or else problems of unidimensionality and reliability will occur. One more reason is that most of the questions belonging to F4 and F7 are considered to be troublesome questions upon the observations of the researcher during data collection. Three of these questions ("Generally speaking, I accept and carry out my boss's decision even though it is different from mine, Generally speaking, I respect and put in practice my colleague's decision, Generally speaking, I try to follow my boss's directions") were dealt with by the respondents in an argumentative and case by case manner and the values chosen to answer them were not representative of the actual situation at hand. Thus, the research team chose to respecify the model by first removing the two items that belong to F7 because these two questions are nowhere near measuring the same construct. Upon running the second model, there was still one undefined component: F4 (appendix G). Similar analysis to the previous run applies. One more reason is that the questions belonging to F4 are troublesome questions upon the observations of the research team during data collection and as indicated in the previous section. Thus, the research team chose to re-specify the model again by removing the two items that belong to F4. Upon running the third model, there were no more undefined components or troublesome items. Hence, the researcher can proceed with the next steps of analysis.

After conducting the thorough steps, SPSS gives the aggregation of variables per factor as shown in a snapshot of the last model from SPSS in Figure 8 and previously in Table 5. Table 6 summarizes these results. Also, the table shows the ID number of each factor and its label. The number of the factor comes from the pattern matrix results. As for the label, it is based on the research team's judgement in reference to the following theoretical background:

- Component 1 labeled contributions- contributions of knowledge sharing to team integration. The first four questions are inquiring about how knowledge sharing would be affecting relationships of the members of the project and the last one is inquiring about a professional or technical support the knowledge sharing process is capable of offering. According to Javernick-Will (2012), the social type of team integration that includes reciprocity acts as a very critical motivator for sharing knowledge under the umbrella of social motivators. Working in a dynamic and interactive environment like the construction site relies on smooth social ties between the contributors by overcoming behavioral barriers (Baiden et al. 2006). This makes it critical to highlight workers' view of their knowledge sharing as a contributor to enhancing team integration as a key player to their intentions to share their tacit knowledge.
- Component 2 labeled perception- intra-team perception of authority and knowledge sharing. Most of the questions are inquiring about how the worker perceives the status of the role of authority in the knowledge sharing process. The fourth question asks about the positive perception of the knowledge sharing process among the team members. In general, the whole status evaluation is based on trusting the decisions and performance of the supervisory role on site. Mach et al. (2010) proved that trust is a predictor of individual behavior and team performance. Accordingly, it is expected that trust from lower levels of the hierarchy to the upper level of the hierarchy encourage better performance of the

workers since the worker would be satisfied with the professional fairness approaches practiced by the supervisors and would feel more comfortable in sharing his knowledge.

- Component 3 labeled performance- assessment of knowledge sharing on project performance. The questions reflect on the product and project side of the work. According to Cox et al. (2003), key performance indicators exist to assess the performance of a construction operation by evaluating employees' performance of a certain task by measuring effectiveness, efficiency, and quality for both workmanship and product. These questions reflect assessment on both the project and product side of the work. The product side (result-oriented) is highlighted by achieving certain objectives. The project side (process-oriented) focuses on the work throughout, such as establishing strong ties between the workers, that make the product. Nevertheless, these questions are reflecting how the worker sees his knowledge sharing valuable to the project and to his colleagues. According to Zhang and Fai Ng (2012), when the worker feels his knowledge sharing is beneficial, he will have a positive attitude to share it.
- Component 4 labeled attitude- attitude towards knowledge sharing. The questions are inquiring about the feeling of the worker towards his knowledge sharing and what it means to him. If he thinks it is harmful, he will be having a negative feeling towards it and accordingly wouldn't be expected to share his knowledge while if he thinks it is enjoyable and valuable then he will probably be sharing it more (Ajzen and Fishbein 1977).
- Component 5 labeled affiliation- team affiliation. The questions are asking about the type of professional relationships between the members of the team. The

worker's feeling of togetherness among the team members motivates his behavior as a team player and contributor to the work through sharing his knowledge (Mitropoulos and Memarian 2012).

Table 6: New Constructs' Labels and Indicators

Factor ID	Variables	Factor Label
F1	My knowledge sharing would strengthen the ties between project members and myself	Contributions: contributions of knowledge sharing to team integration
	My knowledge sharing would get me well-acquainted with new project members	
	My knowledge sharing would expand the scope of my association with other project members	
	My knowledge sharing would draw smooth cooperation from outstanding project members in the future	
	My knowledge sharing would help other project members solve problems	
F2	I can trust my boss's evaluation to be good	Perception: intra-team perception of authority and knowledge sharing
	Tasks which are given to me are reasonable	
	My boss doesn't show favoritism to any one	
	My knowledge sharing with other project members is good	
	My boss thinks that I should share my knowledge with other members in the project	
F3	My knowledge sharing would improve work processes in the project	Performance: assessment of knowledge sharing on project performance
	My knowledge sharing would increase productivity in the project	
	My knowledge sharing would help the project achieve its performance objectives	
	Members in my team keep close ties with each other	
F4	My knowledge sharing with other project members is harmful	Attitude: attitude towards knowledge sharing
	My knowledge sharing with other project members is an enjoyable experience	
	My knowledge sharing with other project members is valuable to me	
	My knowledge sharing with other project members is a wise move	

F5	Members in my team consider other members' standpoint highly	Affiliation: team affiliation
	Members in my team have a strong feeling of unity	
	Members in my team cooperate well with each other	

This is the final model resulting from EFA, which is reached after removing the undefined components and/ or troublesome items. Hence, the researcher can proceed with the next steps of analysis.

4.2.3.6 Validating factor analysis

There are multiple methods to validate models generated by exploratory factor analysis. Given that the literature states that the most direct method for results validation is through a confirmatory perspective, the research team decided to utilize confirmatory factor analysis via structural equation modeling. Moreover, the assumptions and requirements of other validation methods specifically the ones pursuant to the sample size render these methods practically inapplicable to this case.

4.2.4 *Step 4: Perform SEM (CFA and Path Analysis) based on EFA Results*

Before carrying on with the CFA, a new theoretical based model must be developed based on the results of the EFA. Accordingly, a path diagram of causal relationships is established, and theoretical background is provided for support.

4.2.4.1 Develop a Theoretical Based Model and Draw a Path Diagram of Causal Relationships

In reference to the results of the previous step (conducting EFA) that include the aggregation of variables under different constructs and the new labeling for these constructs, the following set of hypotheses were developed. This step is based on interpretation of the literature as well as judgement from observations made on site and the context in which this study was conducted.

Table 7 shows the hypotheses under study. Accordingly, the relationships are linked in a basic path diagram showing the hypotheses ID numbers between them (Figure 9).

Table 7: Hypotheses Developed

Hypothesis ID	Hypothesis
H1	A worker's positive perception of authority and of his colleagues reflects on his sense of team affiliation.
H2	An affiliated team member has a positive assessment of the project's performance.
H3	The more positive the worker's assessment of project performance is, the better is his attitude toward knowledge sharing.
H4	The worker's anticipation of his knowledge sharing contributions drives his attitude toward knowledge sharing.
H5	Worker's attitude toward knowledge sharing is positively correlated with his intention to share knowledge.

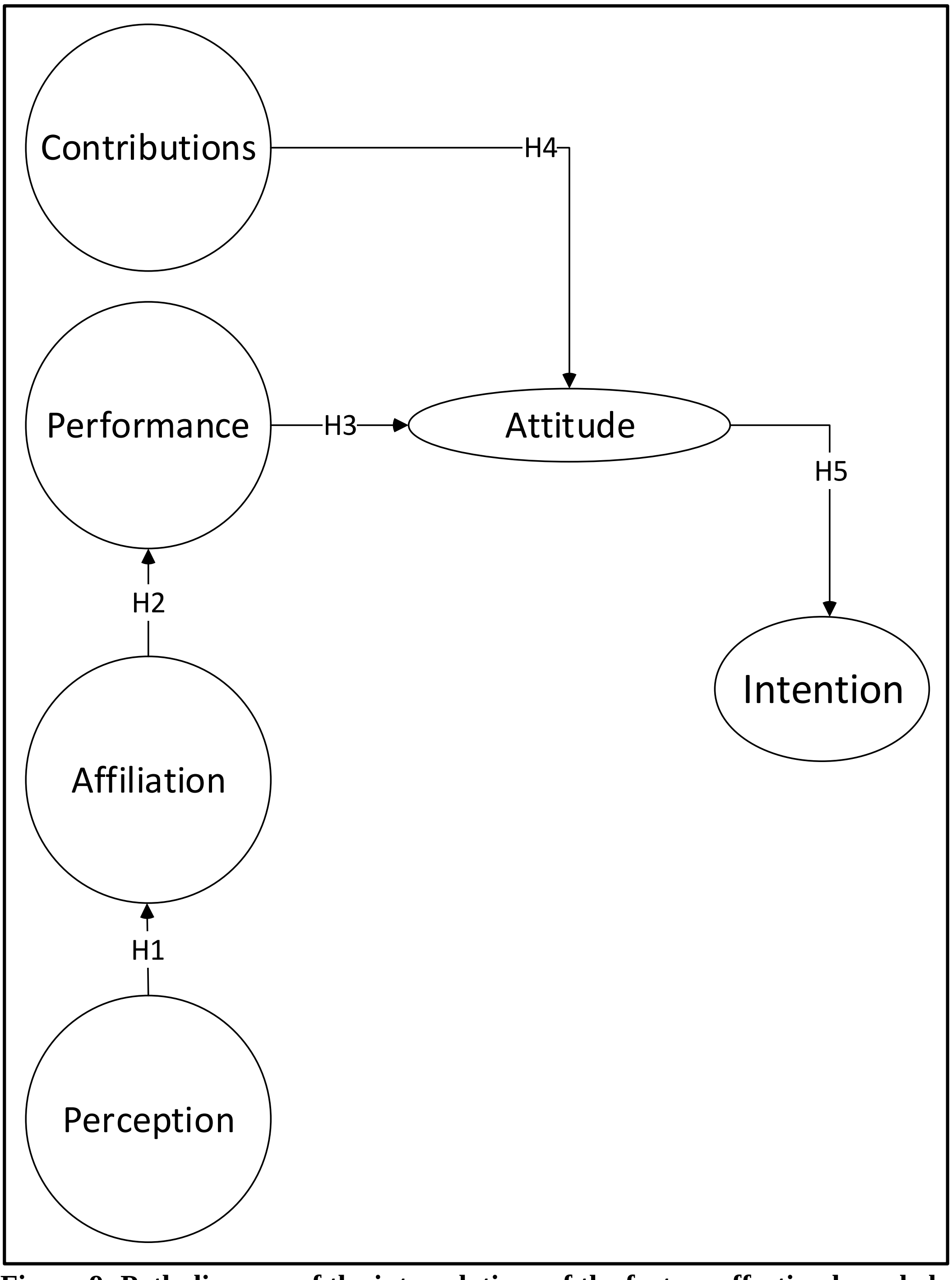


Figure 9: Path diagram of the interrelations of the factors affecting knowledge sharing intentions

H1: An open organizational climate reinforces trust among the workers themselves and their supervisors (Janz and Prasarnphanich 2003). Such trust improves the worker's perception of the social working environment leading to a better sense of team belonging.

H2 and H3: Workers who feel that they belong to a certain organization strive to execute their tasks while maintaining the organization's best interest (Javernick-Will 2012). Due to the known positive correlation between knowledge sharing and organizational performance, affiliated team members tend to be more interested in knowledge sharing to boost performance. Thus, the workers have a more positive attitude toward sharing their knowledge.

H4: When a worker feels the value of his knowledge, he will be more encouraged to communicate it with his team members (Amayah 2013). This reflects upon his views toward contributions of such shared knowledge to team-integration. As such, he will exhibit a positive attitude toward knowledge sharing.

H5: Positive attitude indicates worker's favorable intra-team perceptions, improved affiliation, elevated performance, and constructive contributions. Thus, an individual with a positive attitude towards an action will most probably intend to do it (Ajzen and Fishbein 1977).

It is important to note that the end-goal construct was not included in the EFA analysis since it is the final dependent variable under study. In CFA, the "intentions to share knowledge" construct is of course included in the model. Table 8 shows the endogenous and exogenous constructs for each hypothesis.

Table 8: Updated Endogenous and Exogenous Constructs

Endogenous construct	Exogenous construct
Affiliation: team affiliation	Perception: intra-team perception of authority and knowledge sharing
Performance: assessment of knowledge sharing on project performance	Contributions: contributions of knowledge sharing to team integration
Attitude: attitude toward knowledge sharing	
Intentions: intentions to share knowledge	

4.2.4.2 Converting the diagram into structural and measurement models

A similar procedure to the steps conducted in Step 2 is followed relying on the same assumptions, objectives and decisions. Hence, the changes specific to the new model will be only discussed in this section.

The structural and measurement model are built in accordance to the new set of constructs but with similar manner to what was done in Step 2.1. A snapshot of the first structural model developed in this step is available in Appendix H.

4.2.4.2.1 Correlations among constructs and indicators:

In reference to literature, the correlation that was added by the research team is between the only two independent constructs which are: intra-team perception of authority and knowledge sharing and contributions of knowledge sharing on team integration. If a worker believes that his knowledge sharing is perceived as valuable and he is being appreciated, he will acknowledge that his knowledge sharing has positive contributions specifically when it comes to team-integration (Bock and Kim 2002).

4.2.4.3 Choosing the input matrix type and estimating the proposed model

A similar manner of data inputting is followed in this step as the one done in Step 2.2, but the basic difference is that no outliers were removed in SPSS prior to inputting the matrix into Amos. This is because the constructs were developed in SPSS according to all the data collected; hence, there is no point of finding outliers from this set of data. The sample size of the records used is 137 which is in the acceptable range for SEM.

As for the model estimation, like the results of Step 2, the multivariate normality is not satisfied, and Bollen-Stine bootstrapping is carried out. Upon the first model the Bollen-Stine p-value was low indicating the possibility of a poor fit but that of the last model used had a value higher than 0.05 indicating an improved model fit. The evolution of the model including several runs will be discussed upon the upcoming sections.

4.2.4.4 Assessing the identification of the structural model

In accordance with the steps and explanation in Step 2.3, the number of degrees of freedom of the model is calculated as follows.

The number of measured variables is 24, hence the size of the correlation matrix is 300. As for the estimated coefficients in the model, they are inclusive of the 23 unlabeled weights (labeled weights are those items fixed to 1), 1 covariance (for the correlation imposed earlier), and the 30 variances (24 errors, 4 residuals, and 2 independent variables) adding up for a total of 54. Thus, inputting these numbers in equation 2 results in 246 degrees of freedom for the starting model.

As for the identification rules, they are met in this model since each construct is measured by at least three indicators (questions), and the model is recursive where recursive means that the paths go only in one direction.

4.2.4.5 Evaluating goodness-of-fit criteria

As in Step 2.4, the offending estimates must be checked and once the model is identified as providing acceptable estimates, the goodness-of-fit of the model is checked on two levels: on the overall model and then on the measurement and structural models.

The same acceptable fit levels are referred to and they are in the table in Appendix E.

Measurement model fit is checked by assessing reliability using Cronbach's alpha since the aggregation of the variables on the constructs is not based on pre-established and well-tested study but is determined from exploratory factor analysis. Like in Step 2.4, the estimated factor loadings are assessed, as well as the composite reliability and variance extracted of the constructs in reference to Equations 4 and 5 respectively. Discriminant validity is also assessed.

All the calculations and values of the first and last run of this step are shown in tables in Appendix I. The first run is being shown to demonstrate the first model the research team started with after obtaining the new constructs from EFA and the last run is shown since it is the one to be used in results explanation and discussion.

4.2.4.5.1 Structural model fit:

Typically, the significance of the estimated coefficients is estimated to deem the structural model fit. The Amos output for SEM shows also the standard errors and the associated t values for each coefficient. The research team chose 0.05 as the appropriate significance level to test the statistical significance for each estimated coefficient for the hypothesized causal relationship. Hence, each hypothesis will be examined to see if it is supported or rejected.

Multicollinearity is an issue to think of. Like regression, SEM results can be affected by multicollinearity so the researcher must be careful about the correlations among construct estimates in the SEM results. The researcher should check the output correlation matrix among the latent constructs. In case of large values (greater than 0.9), the researcher should solve this issue by either deleting one construct or redirecting the causal relations. Another way to check for multicollinearity is by checking that the variance inflation factor (VIF) is less than 3. The VIF values are shown for each component under each regression combination (choice of dependent variable) in Table 9. All possible regression combinations have VIF values less than 3; hence, no problem of multicollinearity. Note that this is tested once as it is not changed upon model respecification of errors correlation.

Table 9: VIF Values

Component	Contributions	Perception	Performance	Attitude	Affiliation	Intention
Contributions		1.749	1.445	1.581	1.756	1.767
Perception	1.248		1.250	1.241	1.175	1.259
Performance	1.721	2.085		2.089	1.689	2.071
Attitude	1.466	1.612	1.627		1.616	1.363
Affiliation	1.858	1.742	1.501	1.845		1.872
Intention	1.376	1.373	1.354	1.144	1.377	

4.2.4.6 Interpreting and modifying the model

After concluding that the model is fit and acceptable, the researcher should interpret the results to see if the proposed hypotheses and inferences are accepted. The research team will use both standardized and unstandardized solutions depending on the interpretation objective. Also, upon the need to enhance the model fit, model respecification might take place.

4.2.4.6.1 Standardized vs unstandardized solutions:

Standardized coefficients in SEM have equal variance and a maximum value of 1, so they are approximating effect sizes where a value close to 0 indicates a bare effect and a value close to 1 indicates more importance with respect to the causal relationship. They are used to determine relative importance but not comparable across samples unlike unstandardized coefficients which are expressed in terms of the construct's scale (variance).

4.2.4.6.2 Model respecification:

After interpreting the model, the researcher might be looking for ways to improve the model fit and/ or its correspondence to the underlying theory. This can be achieved by applying model respecification where the researcher can add or delete estimated parameters from the original model such that these modifications are supported theoretically.

A process of model respecification:

The researcher should classify all the relationships regardless if they are estimated or not into two categories: those that are theoretically inferred and those that are empirically inferred. The theoretical relationships (causal relationships between variables and constructs) are inevitable for the model and cannot be modified since they are essential to the underlying theory. As for the empirical relationships (correlations between errors) they are added to improve the fit of the model and thus can be respecified.

Empirical indicators of possible respecification:

Modification indices suggest a change in the model based on how much the chi-square value would change had the coefficient been estimated. A theoretical justification must be available for any change based on modification indices (Hair et al. 1998). The research team in this study relied on modification indices to improve the fit of the model, and each suggested correlation between errors to be added can be supported from theory and common sense.

Upon the first model, the largest improvement in chi-squared value is when e9 and e10 get correlated. Hence, correlating these errors will be the first step of model respecification to carry on run 2.

According to theory this choice was made since respect generally improves the way team members perceive each other's points of view. On the other hand, respect is the key to start new friendships and to establish strong ties with one another.

Similar to run2, the following are the errors correlated at each run and the theoretical justification for these choices:

Run 3 is carried on by correlating e11 and e15. When a boss acts fair with every member of the team, equality is established, and this equality encourages the sense of unity among the team members.

Run 4 is carried on by correlating e9 and e14. When reasonable tasks are given, people feel that there is a sense of justice in the team. Justice yields a positive atmosphere thus encouraging trust and unity.

Run 5 is carried on by correlating e10 and e14. When tasks are distributed in a fair way among team members, they will have more respect to each other.

Run 6 is carried on by correlating e3 and res1. When a worker is more associated with the other project members, he will feel that he belongs to the team.

Run 7 is carried on by correlating e21 and res4. When a worker feels that his knowledge sharing process is a wise move, he will intend to keep on distributing his knowledge.

Run 8 is carried on by correlating e5 and e10. When a worker helps others in solving certain problems, they will tend to appreciate each other's perspective.

Run 9 is carried on by correlating e9 and res4. When members in a team appreciate each other and are friendly, they will want to help each other and hence intend to share their knowledge more.

Run 10 is carried on by correlating e7 and e10. When a worker knows that his contribution will improve the project's productivity, other team members will appreciate his contribution and will respect his insight.

Figure 10 shows the runs conducted in this analysis presenting the number of models that have been tested and all the necessary respecification made in all the steps of statistical analysis.

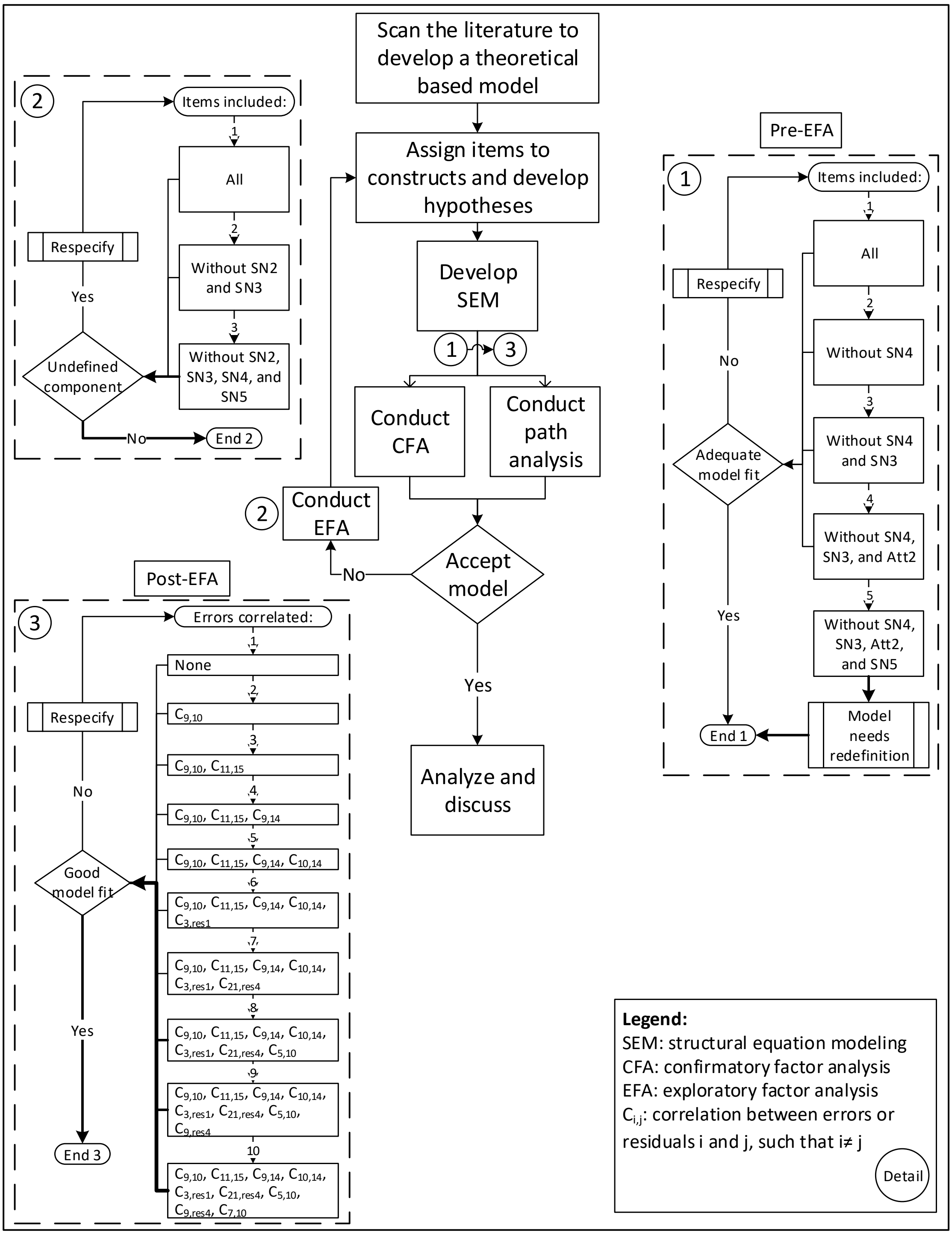


Figure 10: Runs of the modelling strategy

4.3 Descriptive Analysis

The research team relied on mean, standard deviation, and boxplots to describe and analyze the data in context. Mean scores for each construct and for each item were calculated to measure central tendency and standard deviation was calculated to measure variability (Boone and Boone 2012). In general, the standard deviation describes the distribution in relevance to the mean. Mean value is used to describe the average opinion of the respondents and as a way of obtaining a general idea of the perception of the respondents regarding each item. Moreover, boxplots help in describing the data measured by showing distribution, spread, and the central value (Krzywinski and Altman 2014). Accordingly, boxplots for certain constructs were plotted against workers' position. Worker's position is chosen amongst the characteristics of workers since in most cases position varies directly with age and experience so it represents them and workers in the MENA region develop a certain perception and behavior and are as well treated based on the position they hold rather than age and education.

Table 10 shows results of mean and standard deviation for each item and for the corresponding construct while Figure 11 shows the boxplot of performance, attitude, and intention as a function of worker's position. It is critical to study the variability of workers insights on performance assessment upon knowledge sharing since it gives a sense of direction on the long-term effect of this process on the overall project which the contractor eventually cares to see improving. Attitude is studied since it reflects the feelings of the workers towards knowledge sharing which is a critical personal motivator that drives behavior. Intention is studied since it is the end goal dependent variable that reflects workers' behavior towards knowledge sharing the best. This section evaluates these descriptive results upon further analysis in relation to the characteristics of the construction workforce in the MENA region and to explanations quoting the workers' words. As shown in Table 10, the mean scores of the constructs ranged between 4.09 and 4.57 which is considered high while the standard deviation scores ranged between 0.61 to 0.87 which indicates that the responses are not far spread out from the mean. This asserts that the developed knowledge sharing factors are representative.

Table 10: Results of Descriptive Analysis

Construct	**Item**	**Mean of item**	**SD of item**	**Mean**	**SD**
Perception	Fair1	4.23	1.00	4.09	0.72
	Fair2	4.17	0.98		
	Fair3	3.46	1.58		
	Att1	4.41	0.72		
	SN1	4.29	0.84		
Affiliation	Aff2	3.97	1.18	4.13	0.88
	Aff3	4.15	1.18		
	Aff4	4.28	0.91		
Performance	SSW2	4.55	0.70	4.42	0.66
	SSW3	4.61	0.66		
	SSW4	4.51	0.79		
	Aff1	4.03	1.14		
Contributions	ARR1	4.36	0.98	4.35	0.74
	ARR2	4.33	0.98		
	ARR3	4.34	0.93		
	ARR4	4.30	0.99		
	SSW1	4.42	0.90		
Attitude	Att2	1.34 (4.66)	0.72	4.49	0.62
	Att3	4.35	0.94		
	Att4	4.47	0.79		
	Att5	4.20	0.96		
Intention	Int1	4.50	0.78	4.57	0.61
	Int2	4.56	0.71		
	Int3	4.64	0.64		

Note: (4.66) = mean value after reverse coding

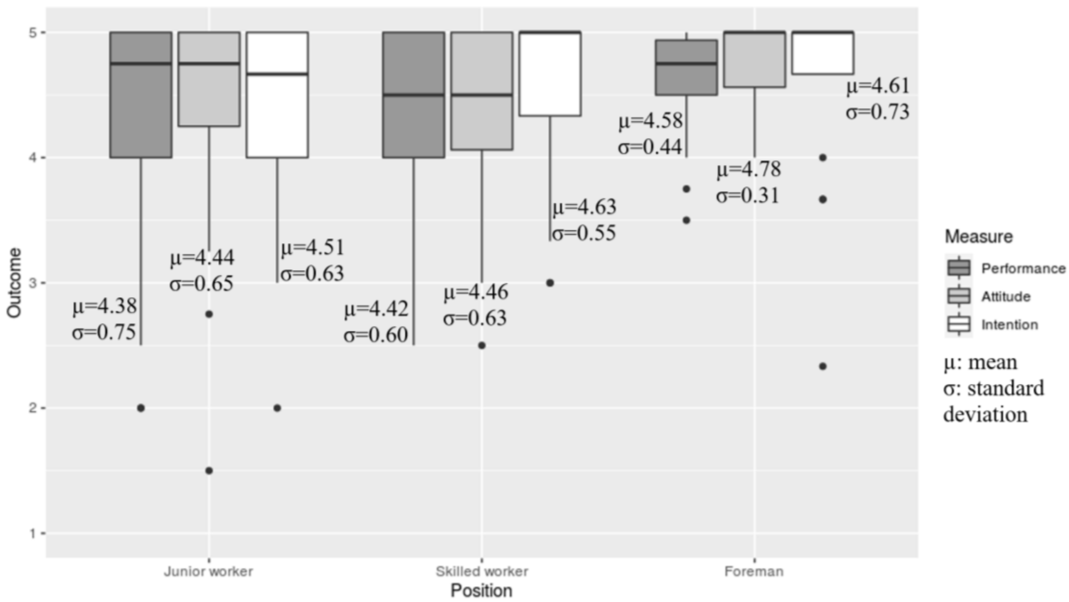


Figure 11: Boxplot of performance, attitude, and intention depending on worker's position

Figure 4 shows that almost more than half of the workers did not finish school hence did not receive a proper level of education that helps them develop an appreciative sense and respect for experienced and more educated individuals. Accordingly, their perception for the role of the boss or supervisor on site will differ, as some will consider his decisions and tactics as well educated while others might not consider his distribution of tasks as wisely judged. This is shown in the variability (SD=1) while answering to Fair1 (Table 10). Other workers probably young ones with limited experience, where 37.96% of the workers are younger than 26 years (Figure 4), might perceive the boss's encouragement for another fellow worker as being biased instead of perceiving it as a means for giving feedback or as a leadership tactic. This is illustrated with the relatively larger standard deviation and lower mean for Fair3 (Table 10).

Nevertheless, experienced workers of higher positions may perceive the knowledge sharing process as a means of delegating certain tasks to less experienced individuals and redirecting their own efforts in supervising other critical activities of the work. Ultimately, they would feel that their knowledge sharing is improving work processes and increasing productivity (mean=4.55 and 4.61; Table 10). Figure 11 shows that foremen appreciate the effect of their knowledge sharing on project performance more than the others (highest mean and median and lowest standard deviation). This might be attributed to the perception of a foreman's role in the MENA region where his supervisors consider him to be the face of the project, so success of the project is measured by the success of his team. According to one foreman "if workers know each other, a good behavior is sustained among them; and if so, better productivity can be achieved". Accordingly, he cares to teach them efficiently which helps them develop closer ties and understand the big picture which in his eyes involves meeting the performance goals of the project rather than just meeting specific assigned tasks as the junior worker thinks (lowest mean; Figure 11).

The mean results in Table 10 indicate that workers believe that their knowledge sharing contributes to enhancing the relationships between them and other project members on the personal and professional levels. Knowledge sharing is a form of cooperation upon which smoother relationships are expected to arise between individuals hence increasing the chances of successfully working towards a common goal.

This is even more asserted by what most of the foremen explained to the research team that in many cases the workers on the same team are relatives which contributes to a higher sense of unity. However, Aff2 yielded a lower mean (Table 10) in accordance with the masculine culture in the MENA region where many workers do not care to consider someone else’s opinion about performing tasks in a certain manner since they either consider themselves more knowledgeable or feel embarrassed for admitting not knowing everything. This is very similar to their behavior with construction safety where they consider that wearing their PPEs at all times makes them look weak and accordingly most of them wear hardhats out of enforcement and not personal incentives or awareness of its necessity (Abbas et al. 2018).

Moreover, the prevailing regional culture of the participants plays a great role in driving the mean scores for the construct attitude. High scores for mean (Table 10) resulted since on one hand, in the MENA region, specifically the Lebanese construction industry, workers brag about the type and amount of knowledge they carry especially in front of less experienced individuals which renders the knowledge sharing exercise enjoyable. On the other hand, they consider it wise since it is considered an opportunity to exchange services or a business transaction process which is valued in the MENA region culture. It is a means for learning from others’ experiences and helping other individuals of the same team “conditioned by guidance but not sharing all information and ideas” according to a middle-aged general foreman. This analysis is further validated by the favorable attitude that foremen have towards knowledge sharing since they are assumed to be the most experienced and knowledgeable (highest mean and median scores for foreman and lowest standard deviation; Figure 11). Nevertheless, in accordance with psychological studies that refer to the importance of compassion in playing a role in activating areas in the brain related to reward (Klimecki et al. 2014), helping others would activate a zone in the brain that provides happiness and satisfaction to the individual offering the help; hence, the worker will definitely think of his knowledge sharing as a valuable exercise to him. It is important to note that the mean score for Att2 is low which is a good indicator that the workers don't consider their knowledge sharing process as being harmful (mean=1.34; Table 10).

Lastly, the survey participants expressed a high inclination to share their knowledge as shown from the high mean value of the factor intention and its indicators. The low standard deviation value indicates that almost all the participants have the same perception (Table 10). The boxplot results (Figure 11) show that junior workers have the lowest mean and median scores and widest variability which might be attributed to some of them (least experienced) being hesitant to share their knowledge in order not to get misjudged or held accountable for not sharing precise information. Skilled workers might be looking to impress their supervisors with the knowledge they have and the leadership skills they are demonstrating while sharing knowledge with those of lower skill level (highest mean; Figure 11). Hence, they are aiming to get entrusted with more responsibilities and step up in positions. Unlike some foremen who might consider sharing all they know as a threat to their role on site, as one foreman clearly said "I can guide them but not tell them the whereabouts of everything I know or else I will get replaced" yet they are all willing to share in the manner of guidance. This shows that foremen are the most willing to share their knowledge but in different manners and for various reasons (highest median and largest standard deviation).

CHAPTER 5

RESULTS

This section shows the assessment of the results of the last model from the statistical analysis.

5.1 Statistical Analysis: Structural Equation Modeling

Upon interpreting the first model, the research team found that the model had weak fit in accordance with the desired values of the overall model fit, accordingly model respecification was performed to improve the fit of the model. As explained in the Analysis Methods section, this was done via the results of modification indices that were used to correlate errors of the indicators and constructs. The errors are referred to as “e” and residuals of constructs are referred to as “res” in Figure 12. The results shown in the following sections are those of the final model.

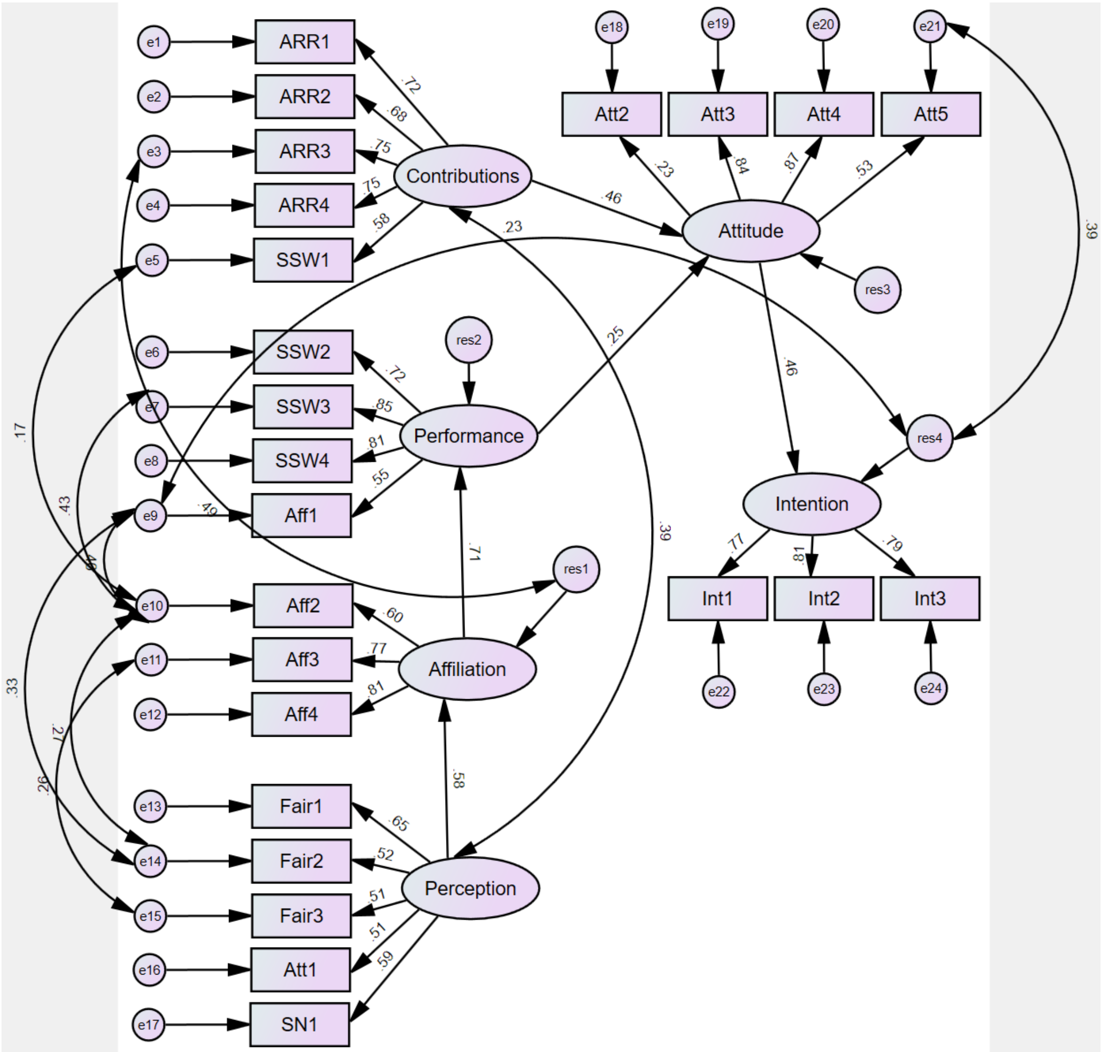


Figure 12: Revised structural model with the standardized path coefficients

5.1.1 *Confirmatory Factor Analysis*

In reference to the acceptable thresholds and recommendations of measures discussed in the Analysis Methods section, the measurement model fit is checked starting by performing reliability and validity analysis. First, construct reliability that expresses internal consistency is checked by finding Cronbach’s alpha of the constructs extracted via EFA. According to Wang et al. (2014), a Cronbach’s alpha value of 0.7 is the lowest agreed upon threshold for acceptance; however, it may decrease to 0.6 in exploratory research (Hair et al. 1998). As shown in Table 11 all constructs have adequate reliability. Convergent validity is assessed through three measures. First, by examining the estimated factor loadings that should be greater than 0.5 and assessing their statistical significance at the 0.05 level (Hair et al. 1998). All items are significant at the 0.01 level and exceed the acceptable loading value (Table 11) except for Att2 that was not removed from the model by the research team since on one hand it is an important indicator and on the other hand the rest of the measures are not affected negatively by its presence. Att2 was reverse coded for the purpose of analyzing its results since it is a negatively worded question. Second, by assessing composite reliability and variance extracted. Composite reliability (CR) shows to which level the indicators can "indicate" the common latent unobserved construct and it must be greater than 0.7 (Hair et al. 1998). The more the measures are reliable, the research team's confidence is higher that the individual indicators are consistent in their measurements. Average variance extracted (AVE) "reflects the overall amount of variance in the indicators accounted for by the latent construct" and it must be greater than 0.5 (Hair et al. 1998). Higher variance extracted values reflects that the indicators truly represent the latent construct. As indicated in Table 11, composite reliability values are satisfactory, but variance extracted for the construct "perception" is below the cut-off. The research team looked at the whole set of statistics to keep constructs and items in the model even if they are characterized with lower statistical values than the others (e.g. perception) since they give intuitive results in accordance with the context of application.

Table 11: Validity and Reliability Analysis Results

Construct	**Item**	**Cronbach's alpha**	**Factor loading**	**CR**	**AVE**
Contributions	ARR1	0.834	0.716	0.825	0.487

	ARR2		0.679		
	ARR3		0.750		
	ARR4		0.754		
	SSW1		0.576		
Perception	Fair1	0.680	0.650	0.693	0.313
	Fair2		0.523		
	Fair3		0.506		
	Att1		0.512		
	SN1		0.591		
Performance	SSW2	0.798	0.725	0.829	0.554
	SSW3		0.852		
	SSW4		0.814		
	Aff1		0.550		
Attitude	Att2	0.727	0.229	0.736	0.451
	Att3		0.841		
	Att4		0.874		
	Att5		0.529		
Affiliation	Aff2	0.798	0.601	0.775	0.538
	Aff3		0.769		
	Aff4		0.813		
Intention	Int1	0.828	0.766	0.830	0.620
	Int2		0.807		
	Int3		0.789		

Discriminant validity is ensured once the square root of the average variance extracted for each construct is greater than the levels of correlations involving the construct (Chin et al. 1997). As indicated in Table 12, all the square root values of the variance extracted values of the constructs meet the condition of being greater than the correlations associated with the construct. Therefore, the results indicate that the model sufficiently meets the convergent validity and reliability criteria and has favorable discriminant validity.

Table 12: Discriminant Validity Results

Construct	Contributions	Perception	Performance	Attitude	Affiliation	Intention
Contributions	**0.70**					
Perception	.181*	**0.56**				
Performance	.588**	.325**	**0.74**			
Attitude	.461**	.281**	.330**	**0.67**		
Affiliation	.452**	.416**	.629**	.368**	**0.73**	
Intention	.273**	.224**	.303**	.499**	.270**	**0.79**

Note: SD = standard deviation. The values are those of correlations while the diagonal bold values are the square roots of AVE.
** Correlation is significant at the 0.01 level (2-tailed).
* Correlation is significant at the 0.05 level (2-tailed).

In CFA the overall model fit indicates the degree to which the specified indicators represent the hypothesized constructs. The overall measurement model fit is assessed by absolute fit measures, incremental fit measures, and parsimonious fit measures. As is shown in Table 13, all fit indices meet satisfactory levels (Diamantopoulos et al. 2000; Fang et al. 2015; Hair et al. 1998; Tabachnick et al. 2007). Therefore, it can be deduced that the measurement model fits the survey data well and it is suitable for testing the research hypotheses.

Table 13: Overall Goodness-of-fit Indices

Goodness-of-fit measure	Level of acceptable fit	Calculation of measure
Absolute fit measures		
Root mean square residual (RMR)	Small values are better	0.094
Root mean square error of approximation (RMSEA)	≤0.08	0.063
Incremental fit measures		

Comparative fit index (CFI)	Higher values are better (≥0.9)	0.905
Incremental fit index (IFI)	Higher values are better (≥0.9)	0.908
Parsimonious fit measures		
Normed chi-square (χ^2/df)	Between 1 and 3	1.547
Parsimonious goodness of-fit index (PGFI)	Higher values are better (>0.5 and <1)	0.661
Parsimonious normed fit index (PNFI)	Higher values are better (>0.5)	0.667
Akaike information criterion (AIC)	Smaller values are better (compared to the 2 models done by Amos)	492.6< 600; 492.6< 1686.739

5.1.2 *Path Analysis*

Figure 12 is the revised structural model with the standardized factor loadings or path coefficients as extracted from Amos. To assess the significance for each hypothesis, the critical ratio (C.R.) value must exceed 1.96 and the p-value must be significant at the 0.05 level (Hair et al. 1998). Table 14 shows the numerical results for each hypothesis along with the assessment of the hypotheses validity. All of the C.R. values are larger than 1.96 except for H3, which is slightly less. All hypotheses are significant at the 0.05 level or even at the 0.001 level except for H3 which can be considered marginally significant. The results indicate that all the hypotheses are verified yet H3 is not considered to be strongly supported.

Table 14: Results for Hypothesis Testing

Hypothesis	**Path**	**Path coefficient**	**C.R.**	**P-value**	**Result**
H1	Perception→Affiliation	0.582	4.233	***	Supported
H2	Affiliation→Performance	0.706	5.838	***	Supported
H3	Performance→Attitude	0.249	1.874	0.061	Weakly supported

H4	Contributions→Attitude	0.463	2.245	0.025*	Supported
H5	Attitude→Intention	0.457	2.245	0.025*	Supported

***Significant at 0.001 level (two-tailed)

*Significant at 0.05 level (two-tailed)

CHAPTER 6

DISCUSSION

This section focuses on discussing the important results shown in the statistical analysis of EFA and SEM as well as those presented in the descriptive analysis in reference to the context of application considering the demographics results and interviews with the workers.

6.1 Theoretical Implications

This study aims at determining a set of factors that are expected to play a role in the construction workers' intentions to share knowledge. The research team relied on existing literature to use previously developed set of factors by seminal works to collect data from the workers. However, these factors do not explicitly match the characteristics of the survey audience; thus, the research team extracted the critical factors for this context of application. This work focuses on using these extracted factors to develop an integrative understanding of the behavior of these construction workers towards knowledge sharing which helps in assessing their intentions to share knowledge upon later studying the causal relationships between them. The developed factors are perception, affiliation, performance, contributions, and attitude. The research team derived the concepts being measured by the indicators of each factor in order to categorize these factors under the personal, social, organizational drivers expected to affect intention as shown in Figure 13. Each factor from each study is shown to have a common concept with another factor from another study and this is demonstrated in

Figure 13 by using the same line type for the outlines of the shapes in which the factors and concepts are presented.

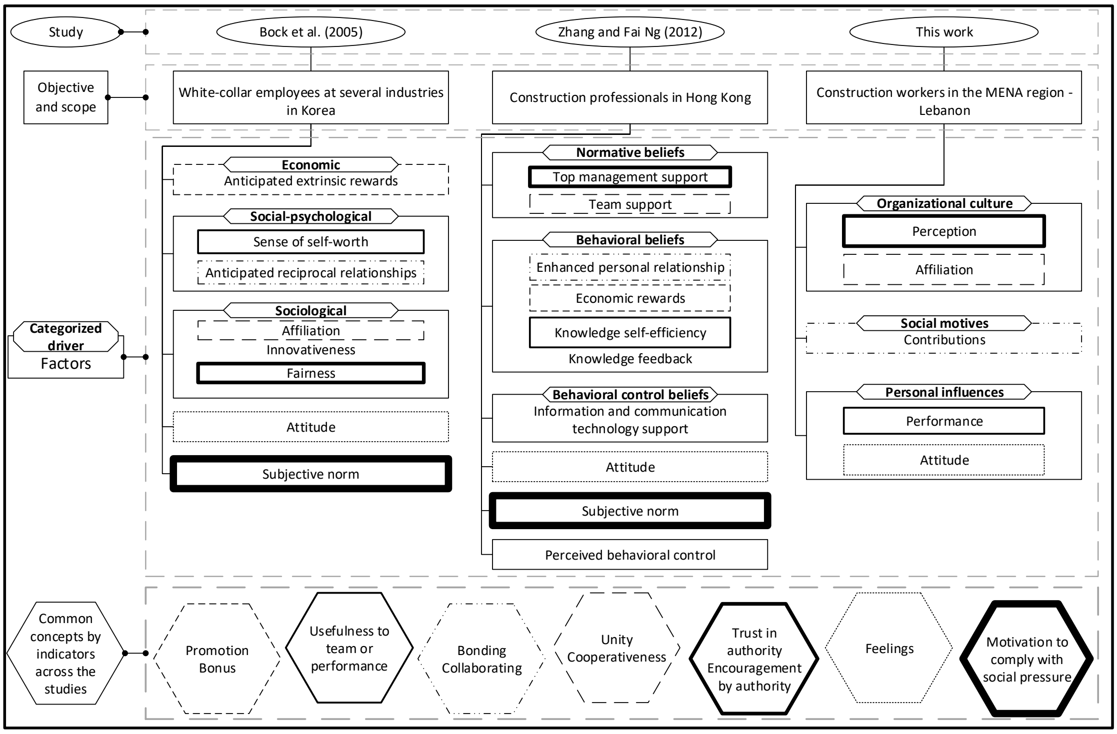


Figure 13: Extracted factors comparison with literature

As described in the research objective, the research team intends to compare the explored factors with previously developed factors of relative works either in methodology like Bock et al. (2005) or professional context like Zhang and Ng (2013) but at different levels of respondents and location of study. Figure 13 shows this comparison and this section justifies the findings.

The first organizational culture factor is perception. It is measuring how much the worker trusts the impartiality in the actions, decisions, and strategies implemented by his supervisor inclusive of being open-minded and encouraging for knowledge sharing. At the white-collar employees' level, fairness factor and top management support factor measure similar concepts to those of perception (Bock et al. 2005; Zhang and Ng 2013). For example, white-collar construction professionals in Hong Kong care more about investigating the supervisory role in supporting knowledge sharing (Zhang and Ng 2013) since according to Yao et al. (2007) top management support among white-collar employees is vital for the success of knowledge sharing.

Another organizational culture factor is team affiliation developed by Bock et al. (2005) that mirrors the professional climate between team members. Its indicators focus on the type of the relationships without mentioning the knowledge sharing exercise since it is important to track team spirit and collaboration regardless of the exercise being studied. However, the case was different for construction professionals where Zhang and Ng (2013) shed the highlight in his questions on team support for the knowledge sharing exercise and how the employees act in its context. It is important to differentiate the type of indicators used to measure the same factors in different contexts because diverse professional level of respondents (intellectual, training, and educational levels) require altered models for assessment.

The research team also assessed social motives by observing the contributions of knowledge sharing on bonding the construction workers and leading to more collaborations. This was hypothesized by Bock et al. (2005) and Zhang and Ng (2013) under anticipated or enhanced reciprocal relationships which in the latter context of application are not perceived as a contribution to team integration. Many of the construction workers in the MENA region specifically in Lebanon are migrant workers who happen to be coming from the same background and social network; thus, they try to join the same projects. According to Thiel (2013), even in the British construction industry migrant workers are appointed by common trades and these workers show to share some basic “class-bound culture”. This is very similar to the case in Lebanon where workers who are appointed to the same teams and projects are relatives, are from the same village or are neighbors which make them belong to the same social network. On the contrary, appointment to white-collar positions happen upon professional specifications and it is not common to have employees belonging to the same community. Nevertheless, the eastern cultures that were previously led by Western colonies, among which are Hong Kong construction professionals, seem to differentiate between personal relationships and work while being in the working environment (Zhang and Ng 2013).

After discussing team related drivers, the research team examined individual or personal influences that include performance and attitude. Performance is an important measure especially among workers on construction sites since it focuses on how they appreciate the impact of their knowledge sharing on project performance such as improving work processes and connectivity of team members thus increasing productivity and reaching goals. According to Bock et al. (2005), this was measured under sense of self-worth reflecting how white-collar employees from all industries see their knowledge sharing exercise as worthy and beneficial to the overall organization performance. Zhang and Ng (2013) on the other hand focused on knowledge self-efficacy that showed how much the construction professionals were confident and capable of providing useful information. This further demonstrates the different context of application calling for the differentiation between both concepts. Questions reflecting on sense of self-worth are used with workers since their supervisors eventually care about the impact of their knowledge sharing on project performance and workers themselves care to recognize how their interjections lead to reaching satisfactory performance as many of the workers noted “it is my source of income, I need to be contributing well to the productivity in order to get paid”. Workers of the MENA region are untrained and mostly uneducated individuals that act by the impulse rather than giving a lot of thoughts on assessing their capabilities and feelings of confidence on the level of usefulness of their knowledge before deciding to share it. This is more of a characteristic to highly educated construction professionals that value the intellectual level of their teammates and thrive to have competent contributions upon building more into their experiences (Zhang and Ng 2013).

In this context of application, attitude is considered as a personal influence rather than just a mediating factor like the other studies. It focuses on measuring feelings where a general characteristic of the workers in the MENA region is that their behavior gets driven by how happy or satisfied, they feel while taking an action regardless of receiving feedback or anticipated rewards. As a matter of fact, both notions are not established in the MENA region construction industry. It is rare that supervisors hold formal training sessions to spread the knowledge and discipline it where workers rely on informal training and observing others to gain their knowledge. Nevertheless, they don’t give feedback for the sake of benefitting the worker and enhancing the knowledge sharing cycle but to get the job done quickly. The industry in the MENA region relies on hiring immigrant workers that require reduced investment in wages and services in order to save on the budget, so they certainly do not promote knowledge sharing by using point system for promotions or monetary rewards as incentives. However, extrinsic rewards were considered among white-collar employees since they rely on point systems and evaluation of performance to get promoted; yet among white-collar employees, monetary rewards are not the type of incentives they seek to motivate knowledge sharing but social recognition is (Cabrera and Cabrera 2002). This is because, according to Kang et al. (2008), Korean employees are afraid of losing the right of intellectual property, competitiveness, and rewards for their ideas upon sharing their knowledge. Due to the previously mentioned reasons factors measuring feedback and rewards were not studied by the research team.

In general, construction projects are temporary investments in the eyes of both the employer and the contractor. This is more specifically true in the MENA region where even contractors do not have fixed crews but hiring and firing and reassigning workers and crews is a common practice. Consequently, there is no serious consideration of time investment for the sake of allowing the workers to innovate especially in basic tasks and no money investment to incorporate information and communication technologies. Hence, unlike the other studies shown in Figure 13, the research team did not study such factors since there is no ground basis for them in the MENA region construction industry.

6.2 Discussion of Hypotheses Results

In this study, perception is identified as an organizational culture driver which if properly managed enhances mutual trust in the organization as noted by Issa and Haddad (2008). Trust means that the receiver of knowledge is persuaded by its sender considering he is being trustworthy similar to how the workers perceive their supervisors as being reasonable and fair in distributing tasks and in treating them. This is another measure of trust to accept to move by the supervisor’s recommendations. As discussed by Issa and Haddad (2008), trust helps create positive behavior while reducing conflicts and promoting a better working environment. This reflects on a better team affiliation behavior just like the hypotheses results show a significant relation of the effect of perception on team affiliation (H1 from Table 14).

However, for the success of the knowledge sharing process, trust must take place on all levels starting with adopting a strong sense of team belonging. On the personal level, workers must trust that the knowledge they want to share is good. On the organizational level, there must be trust that tasks are being equally distributed and given reasonable time to execute so they feel that the system implements fair practices with the workers. This encourages their sense of belongingness since unequal treatment creates jealousy and jealousy divides the team instead of uniting it. On the supervisory level, workers must trust that their supervisors believe in the knowledge they carry and do encourage them to share it. When the workers feel that they have the support of their supervisors to take a certain course of action, they will be more encouraged to do it. Nevertheless, such support from the supervisor allows the workers to be more confident and they will be more willing to carry discussions with their colleagues and consider their points of view for options of tasks execution. This is affirmed with Parker et al. (2006) who said that when employees feel that they are being fairly treated, they intend to share their knowledge more.

Among the organizational culture drivers identified in this study is affiliation which, as indicated by the hypotheses results, significantly influences performance with a large effect as indicated by the large path coefficient (H2 from Table 14). It is critical for any progress of work to have the team members highly affiliated and listen to each other's advice and work as one hand. Nurturing such ties helps them direct their efforts towards their common goals related to project performance. They would better behave as a team and discuss via unformal talks how they can help the project achieve its performance objectives. This is how their communication and exchange of know-how would impact project performance.

Organization performance or project performance improves upon the existence of two basic notions: coherent team and continuous learning. Both aspects are rules to be played by when seeking the interest of the contractor's organization. They are significantly related such that a strongly affiliated team creates an encouraging and competitive environment to learn (Xue et al. 2011) whether this learning comes from one another or from external opportunities such as training, education, and experience. Thus, it is very critical for the success of the attempts of knowledge sharing to improve project performance, to understand the value of it and have a positive assessment of its impacts on work processes.

Javernick-Will (2012) highlighted the important role played by peer recognition as a motive for knowledge sharing. Perhaps Javernick-Will (2012) categorized it as a social motive; yet it can be identified as a way to build the organizational culture of the project participants. Peer recognition would not be properly achieved unless it is coming from a coherent team and in its turn peer recognition is when the workers' efforts towards the interests of the project or contracting company are appreciated. This would make them feel that the expertise they carry is valuable for the overall project motivating them to share it.

Assessment of knowledge sharing on project performance is among the personal influences that drive worker's intentions to share knowledge. According to Ni et al. (2016), since tacit knowledge is highly personal, its sharing is certainly influenced by how much its sharers or participants can see its contributions to the organization.

Similarly, workers need to realize how much their knowledge sharing process can improve work processes and keep close ties between the workers to improve labor productivity. Once such realization is established, they should be more enthusiastic about this exercise and hence more willing to be part of this communication cycle. However, the hypotheses results show a weak link between performance and attitude (H3 from Table 14) because in the MENA region (Lebanese) culture, the workers' contributions are not well appreciated, and they are belittled by their supervisors.

In this culture, it is very controversial how performance affects the workers' attitude. For example, if the workers receive constructive criticism for their work and understand how it is contributing to project performance, they should have a positive attitude in accordance with Gillani et al. (2018) who suggested that upon using the knowledge sharing initiative as a key performance indicator employees will intend to share their knowledge more. On the other hand, if the workers receive negative feedback or do not receive any feedback at all (mostly the case in this culture), they will tend to have a negative attitude towards knowledge sharing. On one hand, this might be the case due to delivering products improperly, so it is easier for the contractor to penalize them and replace them by other workers to redo the job. Yet, they do not receive constructive criticism of how it should be properly done and there does not exist a back and forth discussion to learn from their mistakes for the future and to feel encouraged for sharing the new information they received. However, another reason is the nature of the industry where some bosses are inpatient in teaching or guiding some of the workers that they believe have low intellectual levels. Nevertheless, even if the workers execute the job properly, they do not even receive a simple pat on the shoulder so that they can feel the importance of their executed tasks for the overall project performance and to stay enthusiastic about what they know so that they share it. These are other reasons for the weak link between performance and attitude as indicated by the results of the collected data.

Thus, the model did not seem to show a strong relationship between performance and attitude since in this culture the workers do not realize the worthiness of the knowledge they carry and how much positive impact it has if they share it. The simple mentality held by many of the survey participants (youngest, least educated, and least experienced), that does not appreciate the overall picture behind the knowledge sharing exercise, affects the proposed relationship too. They are still unexperienced and short-sighted so they focus on the short term benefit of finishing the task at hand quickly to get paid rather than the long term benefit of how the know-how each of them carries, if combined, will help the project performance and thus they would feel how much it is worthy to communicate their expertise and feel satisfied about it.

Speaking of worthiness, Ooi et al. (2009) affirms that a better knowledge sharing behavior occurs when the employees feel that their organization appreciates their endeavors to share knowledge. Similarly, the workers need to see that their knowledge sharing is meaningful to their supervisors or even to the engineers and contractor’s personnel. These people’s recognition is seized when they see that the workers’ attempts to teach each other is improving organizational productivity and work relationships. This would make the workers feel that their knowledge sharing behavior is valuable. Lack of performance appraisal in the MENA culture makes the workers lose interest in improving their job and not direct their full focus towards the criticality of the knowledge transfer, that takes place between them, on the overall project performance.

This is unlike other industries that persist on evaluating the work performance of their employees relying on the mistakes done for guidance (Nielsen et al. 2011).

Contributions of knowledge sharing to team integration is identified as a social motivator in this study. The hypotheses results showed that there is a significant positive relationship between such contributions and attitude towards knowledge sharing (H4 from Table 14). Such result aligns with the findings of Fulk (2017) and Xue et al. (2011) on the importance of social influence in directing employees towards identifying closely with their colleagues encouraging them to share knowledge.

It is important to have strong social relationships between the workers since they work for months on the same project and when they feel they are well acquainted with the project participants they will be happier, and this motivates them to work better. One way for achieving this is by feeling more comfortable with their colleagues such that they are more socially confident and willing to share the knowledge they have regardless of whether their teammates are their cousins or are strange individuals whom they have met on the project for the first time. This indicates that they would be willing to have a better attitude towards communication without the cultural need to previously know the participants of this possible knowledge sharing exercise. This means getting socially motivated pushes them to share knowledge in alignment with the findings of Javernick-Will (2012) that show the popularity of social motivations as a driver for sharing knowledge.

Trust is a key player to feel comfortable and socially belonging to the team. As realized by Zhang and He (2015), who discussed the role of trust as a social driver for members of integrated project delivery, different types of trust develop upon forming the team. When the workers realize that they have common goals and duties upon communication, swift trust develops between them. Swift trust develops at the early stage of team formation since it is based on role-based interactions (Robert et al. 2009). More importantly, according to Zhang and He (2015), upon sharing information and establishing reciprocity, members of the project will develop information-based trust. Finally considering such interactive informal discussions, the teammates will develop emotional bonds and accordingly strong team integration; thus identification-based trust (Zhang and He 2015). All these trust types are proven to have a positive influence on individual's feelings and perceptions for tacit knowledge sharing (Zhang and He 2015).

The relationship between trust and the behavior towards knowledge sharing is two-ways. When there is trust between the employees such that they know each other and acknowledge their honorable reputations, knowledge sharing becomes more valuable (Parker et al. 2006). This aligns with the findings of Gillani et al. (2018) that trust builds social ties. On the other hand, a systematic learning and teaching process contributes successfully to the social network and team integration. Other than feeling that their knowledge sharing is valuable, they would start to feel that it is wise since they are able to see its benefits. These are two examples of how the workers' contributions to team integration positively influences their attitude towards knowledge sharing affirming the results obtained.

As for the other personal driver, attitude, aligning with a number of studies starting with Fishbein and Ajzen (1977) and the theory of reasoned action to Bock et al. (2005), Chatzoglou and Vraimaki (2009), Tohidinia and Mosakhani (2010), Xue et al. (2011), Zhang and Ng (2013), and Zhang and Fai Ng (2012), the results of this study confirm that attitude significantly determines behavioral intention (H5 from Table 14). When the workers have a positive attitude towards knowledge sharing by feeling it is wise, enjoyable and valuable to them, they are inclined to exercise it more. In the MENA region culture valuing reciprocity makes the knowledge sharing exercise valuable to the workers due to the concept of giving back to the others what was received from them as an example of exchanging services or in this case information. This was proven by Javernick-Will (2012) to be one of the most important social motivators to share knowledge.

Attitude is also playing a mediating role between other personal influences and social motives on one hand and intention on the other hand in accordance with previous studies discussing how behavioral beliefs impact attitude and in its turn influences intention (Zhang and He 2015). Among white-collar employees in the Hong Kong construction industry, sense of self-worth is a behavioral belief that was proven to significantly affect attitude (Zhang and He 2015). Unlike the result of this study, enhanced personal relationships among Hong Kong construction professionals was proven not to influence their attitude towards knowledge sharing (Zhang and He 2015). Another contradiction of the results of this work with literature, is a conclusion by the study by Bock et al. (2005) involving Korean white-collar employees across several industries, that sense of self-worth or what resembles employees' knowledge sharing usefulness for the organization does not have any effect on attitude towards knowledge sharing. These are a couple of examples that further justify the differences in the drivers of workers' intentions to share knowledge and the status of the hypothesized underlying relationships between the factors depending on the context of application and the culture of countries where these studies took place.

6.3 Practical Implications

According to construction professionals and practitioners of the construction industry in the MENA region, there is an absence of awareness of the effects of crew assignments and communication on the progress of work and project performance. This industry lacks the availability of human resource management strategies (Srour et al. 2006) and accordingly, in Lebanon, relies on traditional methods of recruiting workers such as appointing random low paid migrant untrained workers. Thus, it becomes very important to make use of the results obtained on assessing several factors under personal, organizational, and social drivers that translate workers' perceptions of their working environment and show some of the weak elements that might drive their professional actions, in general, and knowledge sharing behavior, in particular, in an undesirable direction.

To help contractors and construction practitioners better direct the efforts of their labor in a more productive manner, the research team will be offering some suggestions upon the analysis of the descriptive results for the workers to have better sense of behavioral beliefs hence favorable attitudes and encouraging behavior towards communication and knowledge sharing (Ajzen 1991). According to Ni et al. (2016), knowledge sharing performance among project members within project management organizations is affected by the knowledge sharing culture. Where knowledge sharing culture is determined by following a knowledge sharing strategy, maintaining a knowledge sharing climate, promoting a knowledge sharing incentive, and empowering organizational members trust. The case is assumed to be similar among construction workers where the research team suggest methods to implement similar fundamentals to those by Ni et al. (2016) among others to improve knowledge sharing performance on construction sites.

According to Humphreys et al. (2008) and Wickramasinghe and Widyaratne (2012) an effective knowledge sharing process takes place in a trusting atmosphere where individuals identify with one another. Similarly, the construction workers need to have a strong trust relationship with the system that they belong to. Holste and Fields (2010) differentiated between two types of trust relationships among team members and supervisors. According to them, it is important to empower cognition-based trust that depicts how much workers view other co-workers or supervisors as reliable and competent (Holste and Fields 2010). Workers need to trust the intentions of their supervisors and accept that they are more experienced from them and have different insights to how tasks are distributed and executed. On the other hand, supervisors need to improve their communication mechanisms with the workers to make sure they are being understood properly. It is not in their interest that some junior workers feel unwanted on a team or unfairly treated when the supervisors give so much attention to other workers because they share the same nationality, are relatives, or simply have been in business together for years as some of the workers clarified to the research team. The supervisors should maintain a fair treatment among workers, so they also gain their trust in return- affect-based trust and are able to influence their team behavior (McAllister 1995) especially in participating actively in knowledge sharing activities.

Upon discussion with the workers, one foreman noted the importance of getting well-acquainted with the workers before assigning them to teams. He emphasized on getting to know the skill level of each worker and in which crews they would be more efficient moving by the system of assigning novice workers to groups with more experience to learn from. This is an example of a good knowledge sharing climate with an endeavor for a systematic organizational learning environment that is expected to have a positive impact on knowledge sharing behavior (Ni et al. 2016). Another method to be followed by supervisors is helping junior workers gain confidence in the knowledge they carry by giving them feedback and pep talks. This demonstrates respect for the knowledge holders in the project as a part of improving the knowledge sharing climate (Ni et al. 2016) so they contribute knowing it is helping solve problems. Sorakraikitikul and Siengthai (2014) suggest that a friendly learning environment enables an efficient knowledge sharing behavior; yet one barrier for such a climate in the Lebanese construction industry is the negative perception many of its practitioners have for diverse workers' ethnicities since it mainly relies on migrant workers (Srour et al. 2017). Accordingly, it is vital for smooth progress of the work to have a good bonding between workers from different nationalities. Migrant workers discussed with the research team the effect of ethnic discrimination on team integration and how they are not welcomed among their local counterparts as one worker explicitly said, "Lebanese workers do not perceive me as worthy enough to share their knowledge with me since I'm a migrant". Local workers especially of outstanding positions have a sense of superiority over the migrant ones and do not accept the importance of how their knowledge sharing might improve cooperation. Thus, practitioners should take serious actions upon raising awareness against discrimination and the importance of knowledge sharing to providing insightful collaboration chances. It is a reciprocation instance where according to Liao et al. (2004), as the relationship between the individuals better, the tendency towards voluntary knowledge sharing increases.

In accordance with Xue et al. (2011), team climate influences the knowledge sharing behavior. Given that the construction site is a work environment that strongly relies on teamwork, it is vital to ensure team spirit and discussions among different points of view for any progress of work to take place inclusive of knowledge sharing activities. The supervisors must nurture the sense of belongingness by promoting work contact through engaging the workers with face to face discussions and showing them how engineers can also listen to and discuss the foremen's suggestions even though they belong to different levels of the hierarchy; hence, demonstrating a strong example of unity. Similarly, the foremen are to carry on discussion sessions among assigning tasks to skilled workers and the latter are to do so with junior workers. This approach helps in nurturing team affiliation and makes it more encouraging to the workers to engage in team behavior by having better interpersonal relationships and more communication.

In accordance with Javernick-Will (2012), employees feel that they will be more recognized and worthy to the organization when they share their knowledge. Similarly, supervisors should highlight the impacts of workers' communication on the progress of the works. Better communication means stronger ties and upon solid relationships efforts are directed towards achieving common goals (Kent and Becerik-Gerber 2010). Among these goals is increasing productivity, which is what the contractor cares about, the output of any team related behavior and how it is impacting the advancement and quality of work. The workers need to be always reminded of why they should constantly communicate and how much each task each member of the team is executing is worthy for the project performance. They need to be given feedback by their supervisors whenever they are observed to share knowledge and need to feel how much every task they learn and communicate influences positively the quality of work and their productivity.

Moving on to the culture within the Lebanese construction sites which do not rely on extrinsic incentives to encourage knowledge sharing behavior; thus, efforts must be directed towards status recognition that has been found in another working environment to be more effective than financial incentives (Carrillo et al. 2004; Javernick-Will 2012; Sheehan 2000). The supervisors need to show some appreciation and recognition of the workers' endeavors at communicating and teaching each other so that they feel it is a beneficial and enjoyable exercise for them to continue with and to aim at improving. This enjoyment along with knowledge self-efficacy are examples of intrinsic motivational factors that workers need to move by (Ho and Kuo 2013).

Another attempt to encourage knowledge sharing is when the engineer or foreman is granted a learning opportunity upon attending workshops, and he shares what he learned from these training sessions with the skilled and junior workers. This adds to their knowledge on one hand and inspires them to develop their skills and exchange information of know-hows and know-where with other workers on the other hand. This aligns with the findings of Javernick-Will (2012), when leaders demonstrate knowledge sharing initiatives, their followers will tend to mimic their behavior.

6.4 Example from the Framework to Optimize Construction Workers' Behavior towards Knowledge Sharing

The research team wants to build a framework for the contractors or construction professionals who appreciate knowledge management and seek the interest of their organization. This framework is to be used in any part of the world at the level of construction workers to optimize their behavior towards knowledge sharing and hence have improved productivity and better project performance. The framework relies on the hypotheses results of the extracted constructs that were proven to affect workers' intentions to share knowledge based on the collected data in Lebanon. The links or relationships between the constructs play a great role in determining the areas that require focus and the descriptive results and observations allow for a better assessment of the weaknesses that might be encountered in such work environments. Key professional factors are to be identified for each set of indicators of each construct through the research team's judgment or with support from literature. Upon identifying such key aspects relevant to construction labor work environment, suggestions will be given for a set of tactics or approaches to be followed by the supervisors of the workers who engage in knowledge transfer to have it done more efficiently and to have a more successful knowledge sharing exercise to maintain such knowledge capital and to improve work processes. The impacts of such suggestions will be also pointed out by the research team considering the hypotheses results and literature support on one level and the direct practical consequences on another level. The following paragraphs and Figure 14 demonstrate one example of this framework.

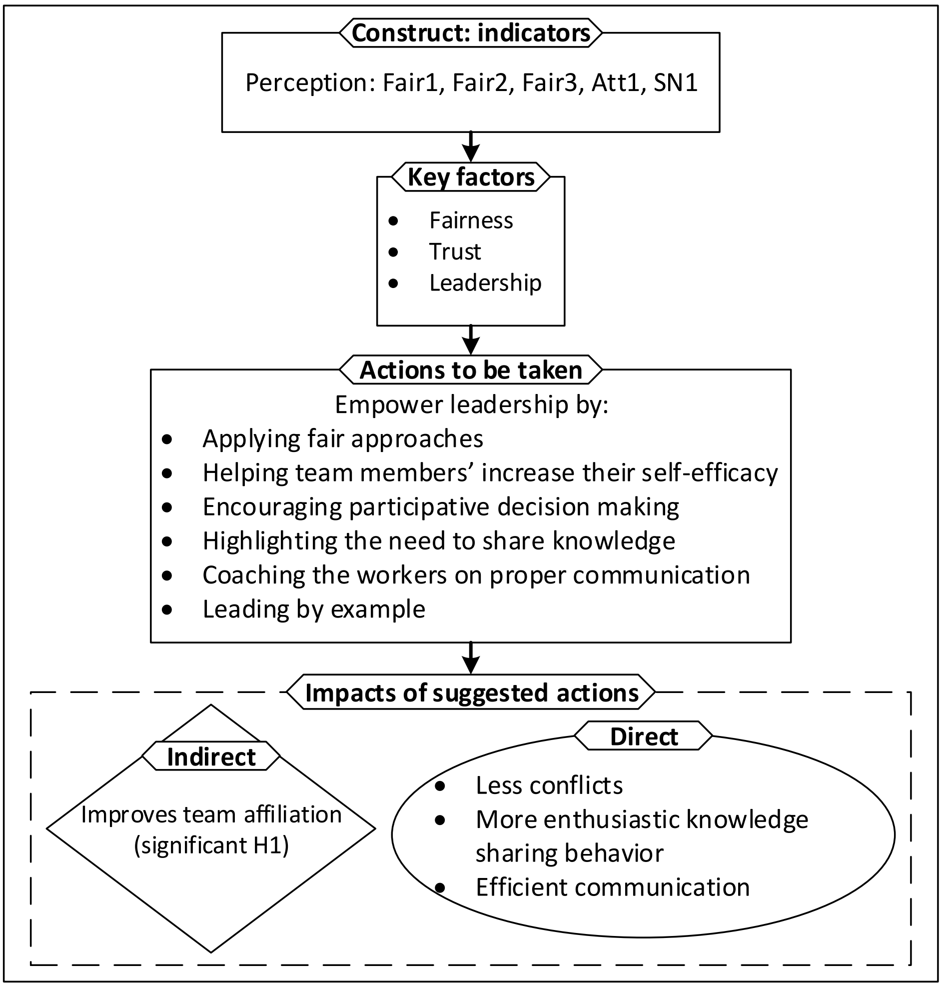


Figure 14: Framework example for construction professionals

The first construct that will be assessed is intra-team perception of authority and knowledge sharing. Upon examining its indicators and what they are measuring, the research team identified fairness, trust, and leadership as the key factors that require attention.

Leadership must be empowered since as previously proven it improves employees job autonomy (Townsend and Bennis 1997). First, the supervisors should be trained to apply fair approaches with their team such as treating them all equally regardless of their nationality, level of education, years of experience, or years of being in business together. Everyone should be given tolerable tasks and reasonable amount of time to execute them considering their skill level. The supervisors should be made aware of the consequences of showing favoritism to any of the workers. In case the supervisor wants to appraise a job or a suggestion by any of the workers, he should be very aware of how to convey the message in a complementary and encouraging manner that motivates the fellow workers to act likewise rather than conveying it in a way that gets viewed by the other workers as favoriting a particular worker over them which will demotivate the workers and affect their performance. This is supported by Xue et al. (2011), who discussed how leaders can help team members' increase their self-efficacy and control over their work environment. Upon gaining such confidence accompanied with proper guidance, they can better judge whether they have enough information to make task-related decisions on their own. Hence, they will be carrying out discussions with their colleagues upon making such decisions.

In this context, leadership gets empowered when the supervisors know how to treat the workers in a fair manner on one hand as previously discussed and a motivational manner on the other hand. The supervisors should always be reminded of the pivotal role they have as being role models and that the workers on their teams intend to imitate their behavior. Accordingly, if the supervisors cooperate with each other, discuss with the engineers, and teach their respective workers, all workers will acknowledge the importance of communication since it is being constantly practiced by their supervisors. When supervisors share success stories of implementing information obtained from other team members, they are encouraging participative decision making (Arnold et al. 2000). The supervisors should also explicitly highlight the need to share knowledge and keep on reminding the workers to do so by pointing out the benefits of such exercise on the workers' set of skills and amount of information and level of know-how that would eventually help them progress. The supervisors should act as leaders that know their team very well and know how to persuade them to take a certain course of action. Accordingly, they should coach them on proper communication and provide them with opportunities for collaboration (Arnold et al. 2000).

Other than trust, responsibility and commitment are two important concepts that leaders hold. Accordingly, when leaders act in a manner that shows that they are responsible for the tasks that have been assigned to them by the engineers and that they seek help or guidance from other well experienced individuals on site via unformal verbal communication, they are acting in responsibility and showing commitment to their work. If this is properly depicted in front of the workers, they should adopt a similar behavior. This was also identified by Arnold et al. (2000), as leading by example.

Such tactics if properly applied will have positive indirect and direct impacts that first will make the communication smoother and more efficient and will eventually lead to better performance while maintaining knowledge capital. Improving intra-team perception of authority and knowledge sharing improves team affiliation due to the proven significant relationship between them. There will be less conflicts and fights between the workers that usually arose from jealousy. Efficient communication will take place and there will be more opportunities for the workers to provide suggestions and take part in decision-making which will make them feel that they are valuable to the organization. Hence, workers will adopt a more enthusiastic behavior towards knowledge sharing due to being inspired by supervisors (leaders) and being part of the decision-making process.

CHAPTER 7

CONCLUSION AND FUTURE WORKS

Labor productivity is proven to be a key player in defining construction project's performance; yet there are not enough actions taken for targeting its weaknesses especially in developing countries such as those in the MENA region. One identified factor affecting labor productivity is communication or what is referred to as the knowledge sharing process. Accordingly, this study is one among the first endeavors for studying the knowledge sharing process among construction workers and identifying the origin of its weaknesses and presenting a set of approaches to increase labor productivity. The research team did an extensive literature review seeking studies in the knowledge management to start from. After identifying a seminal study, they established a survey questionnaire to understand the process and weaknesses of the knowledge sharing process that takes place between construction workers. They started with hypothesizing the links between factors from literature that were proven to influence white-collar employees' knowledge sharing behavior. They conducted confirmatory factor analysis to test the structure of the model among the MENA region blue-collar workers. However, due to the very different context of application from the studies in the literature, the research team had to conduct exploratory factor analysis on data collected from blue-collar workers to extract a set of factors playing a role in directing their individual and team behaviors towards knowledge sharing. These factors are contributions to team integration, intra-team perception of authority, assessment of knowledge sharing on project performance, team affiliation, and attitude towards knowledge sharing which were categorized under a set of organizational, personal and social drivers.

This work contributes by adding new constructs to the construction knowledge management literature from the performed EFA to understand the drivers behind behavior of workers. Furthermore, such findings were validated in accordance with seminal works upon regional and contextual comparisons. Practically speaking, the research team made suggestions of on-site strategies to improve individual and team behavior of construction workers considering the weaknesses spotted in the analysis. These weaknesses are very specific to the working culture considering team affiliation and trust in authorities as well as the level of friendliness of the work environment.

Furthermore, the research team built a new model of causal relationships between the extracted factors to study their possible impact on intentions of workers to share their implicit knowledge. This model was tested through performing structural equation modeling. The model was assessed for goodness of fit, and the results showed good fit measures indicating that it is representative of the data. The results showed that all the relationships are significant except for one which was weakly supported considering the characteristics of the respondents. One example of the results was used to suggest ways to optimize the workers' behaviors reflecting on the possible direct and indirect impacts that improve labor productivity and eventually project performance.

This research work's contributions to the body of literature in the field of construction management include conducting advanced statistical analysis methods that were described in details and using mixed analysis methods (quantitative and qualitative) to identify the factors affecting knowledge sharing behavior and intentions of construction workers in the MENA region. The research team also contributed practically to the construction industry by first suggesting ideas to the supervisors in the MENA region- Lebanese construction industry to have a more effective team and individual behaviors on construction sites that will result in successful knowledge transfer focusing on the spotted weaknesses from descriptive results and interviews with the workers. Also, they have suggested general tactics that can be applied to construction sites and among construction workers in any location in the world to improve the knowledge sharing exercise based on the hypotheses results.

Nevertheless, this research work has some limitations or challenges encouraged to be addressed in future works. The discussion presented might be culture specific to one country in the MENA region; thus, the research team is working on a framework that was briefly discussed to generalize the findings of this study to meet up the needs of the construction industry at the level of the construction workers regardless of the region. Considering the results at hand, practitioners may carry analogies with their location of application and hence alter the presented suggestions to match their organizational culture.

Another limitation is the scope of the study that focused on targeting construction workers of diverse trades yet pertaining to construction buildings only. It would be interesting to see how results might differ for other types of construction projects such as transportation and infrastructure. Another interesting aspect to study is considering various trades of workers such as the difference between MEP technicians and steel fixers. Nevertheless, Lebanon was the testbed for this study; however, the research team do not claim that it is representative of all the MENA region so carrying studies in other countries of the region is highly encouraged. Also, the research team recognize the value of expanding the model to include more factors such as cognitive barriers for communication considering time and resources. One example of resources is using advanced technologies to study how such implicit knowledge can be codified and documented. Such as studying how artificial intelligence along with augmented or virtual reality can be used to videotape the discussions occurring between the workers and maybe later replayed as part of training sessions.

Considering the model itself, a larger dataset is encouraged to reassure the validity of the model on larger scale. Also, it would be interesting to compare the hypotheses results with other studies from literature of knowledge management inclusive of other industries and other participants. The research team would like to focus more on knowledge management endeavors and assess the practicability of the implicit knowledge sharing process among construction workers considering both factors of time and success.

APPENDICES

Appendix A: Survey versions

English version of survey

Knowledge Sharing Intention

Knowledge is defined as the individuals' professional experiences and know-how that help in performing professional tasks. Knowledge sharing refers to the transfer of knowledge from one individual to the other. Knowledge could be shared through informal discussions and chats, formal meetings, and knowledge management and information systems.

Background

1. **Gender**

   Mark only one oval.

   - ◯ Male
   - ◯ Female
   - ◯ Prefer not to say
   - ◯ Other: ____________________

2. **Age**

   Mark only one oval.

   - ◯ 16-25
   - ◯ 26-35
   - ◯ 36-45
   - ◯ 46-55
   - ◯ 56+

3. **Experience**

   Mark only one oval.

   - ◯ 0-4
   - ◯ 5-9
   - ◯ 10-14
   - ◯ 15-19
   - ◯ 20-24
   - ◯ 25-29
   - ◯ 30+

4. **Education**
Mark only one oval.

- ◯ Elementary
- ◯ Middle
- ◯ Secondary
- ◯ Technical
- ◯ Bachelors
- ◯ Other: ______________________

5. **Position**
Mark only one oval.

- ◯ Foreman
- ◯ Skilled Worker
- ◯ Unskilled Worker
- ◯ Other

Anticipated Reciprocal Relationships

Please select an answer: 1:Strongly Disagree, 2: Agree, 3: Neutral, 4: Agree, 5: Strongly Agree

6. **My knowledge sharing would strengthen the ties between project members and myself**
Mark only one oval.

	1	2	3	4	5	
Strongly Disagree	◯	◯	◯	◯	◯	Strongly Agree

7. **My knowledge sharing would get me well-acquainted with new project members**
Mark only one oval.

	1	2	3	4	5	
Strongly Disagree	◯	◯	◯	◯	◯	Strongly Agree

8. **My knowledge sharing would expand the scope of my association with other project members**
Mark only one oval.

	1	2	3	4	5	
Strongly Disagree	◯	◯	◯	◯	◯	Strongly Agree

9. **My knowledge sharing would draw smooth cooperation from outstanding project members in the future**
Mark only one oval.

	1	2	3	4	5	
Strongly Disagree	◯	◯	◯	◯	◯	Strongly Agree

Sense of Self-Worth

Please select an answer: 1:Strongly Disagree, 2: Agree, 3: Neutral, 4: Agree, 5: Strongly Agree

10. **My knowledge sharing would help other project members solve problems**
Mark only one oval.

	1	2	3	4	5	
Strongly Disagree	◯	◯	◯	◯	◯	Strongly Agree

11. **My knowledge sharing would improve work processes in the project**
Mark only one oval.

	1	2	3	4	5	
Strongly Disagree	◯	◯	◯	◯	◯	Strongly Agree

12. **My knowledge sharing would increase productivity in the project**
Mark only one oval.

	1	2	3	4	5	
Strongly Disagree	◯	◯	◯	◯	◯	Strongly Agree

13. **My knowledge sharing would help the project achieve its performance objectives**
Mark only one oval.

	1	2	3	4	5	
Strongly Disagree	◯	◯	◯	◯	◯	Strongly Agree

Affiliation

Please select an answer: 1:Strongly Disagree, 2: Agree, 3: Neutral, 4: Agree, 5: Strongly Agree

14. **Members in my team keep close ties with each other**
Mark only one oval.

	1	2	3	4	5	
Strongly Disagree	◯	◯	◯	◯	◯	Strongly Agree

15. **Members in my team consider other members' standpoint highly**
Mark only one oval.

	1	2	3	4	5	
Strongly Disagree	◯	◯	◯	◯	◯	Strongly Agree

16. **Members in my team have a strong feeling of unity**

Mark only one oval.

	1	2	3	4	5	
Strongly Disagree						Strongly Agree

17. **Members in my team cooperate well with each other**

Mark only one oval.

	1	2	3	4	5	
Strongly Disagree						Strongly Agree

Fairness

Please select an answer: 1:Strongly Disagree, 2: Agree, 3: Neutral, 4: Agree, 5: Strongly Agree

18. **I can trust my boss's evaluation to be good**

Mark only one oval.

	1	2	3	4	5	
Strongly Disagree						Strongly Agree

19. **Tasks which are given to me are reasonable**

Mark only one oval.

	1	2	3	4	5	
Strongly Disagree						Strongly Agree

20. **My boss doesn't show favoritism to any one**

Mark only one oval.

	1	2	3	4	5	
Strongly Disagree						Strongly Agree

Attitude toward Knowledge Sharing

Please select an answer: 1:Strongly Disagree, 2: Agree, 3: Neutral, 4: Agree, 5: Strongly Agree

21. **My knowledge sharing with other project members is good**

Mark only one oval.

	1	2	3	4	5	
Strongly Disagree						Strongly Agree

22. **My knowledge sharing with other project members is harmful**
Mark only one oval.

	1	2	3	4	5	
Strongly Disagree	◯	◯	◯	◯	◯	Strongly Agree

23. **My knowledge sharing with other project members is an enjoyable experience**
Mark only one oval.

	1	2	3	4	5	
Strongly Disagree	◯	◯	◯	◯	◯	Strongly Agree

24. **My knowledge sharing with other project members is valuable to me**
Mark only one oval.

	1	2	3	4	5	
Strongly Disagree	◯	◯	◯	◯	◯	Strongly Agree

25. **My knowledge sharing with other project members is a wise move**
Mark only one oval.

	1	2	3	4	5	
Strongly Disagree	◯	◯	◯	◯	◯	Strongly Agree

Subjective Norm

Please select an answer: 1:Strongly Disagree, 2: Agree, 3: Neutral, 4: Agree, 5: Strongly Agree

Normative beliefs on knowledge sharing (NOB)

26. **My boss thinks that I should share my knowledge with other members in the project**
Mark only one oval.

	1	2	3	4	5	
Strongly Disagree	◯	◯	◯	◯	◯	Strongly Agree

27. **My colleagues think I should share my knowledge with other members in the project**
Mark only one oval.

	1	2	3	4	5	
Strongly Disagree	◯	◯	◯	◯	◯	Strongly Agree

Motivation to comply (MTC)

28. **Generally speaking, I try to follow my boss's directions**
Mark only one oval.

	1	2	3	4	5	
Strongly Disagree	◯	◯	◯	◯	◯	Strongly Agree

29. **Generally speaking, I accept and carry out my boss's decision even though it is different from mine**
Mark only one oval.

	1	2	3	4	5	
Strongly Disagree	◯	◯	◯	◯	◯	Strongly Agree

30. **Generally speaking, I respect and put in practice my colleague's decision**
Mark only one oval.

	1	2	3	4	5	
Strongly Disagree	◯	◯	◯	◯	◯	Strongly Agree

Intentions to Share Knowledge

Please select an answer: 1:Strongly Disagree, 2: Agree, 3: Neutral, 4: Agree, 5: Strongly Agree

Intention to share implicit knowledge

31. **I intend to share my experience or know-how from work with other project members more frequently in the future**
Mark only one oval.

	1	2	3	4	5	
Strongly Disagree	◯	◯	◯	◯	◯	Strongly Agree

32. **I will always provide my know-where or know-whom at the request of other project members**
Mark only one oval.

	1	2	3	4	5	
Strongly Disagree	◯	◯	◯	◯	◯	Strongly Agree

33. **I will try to share my expertise from my education or training with other project members in a more effective way**
Mark only one oval.

	1	2	3	4	5	
Strongly Disagree	◯	◯	◯	◯	◯	Strongly Agree

Arabic version of survey

الموضوع: الرغبة في مشاركة المعرفة

نقصد بالمعرفة أنّها التجارب المهنية الفردية والخبرات التي تساعد على تأدية المهام المهنية. أمّا مشاركة المعرفة، فهي انتقالها من فرد إلى آخر. ويمكن أن يتمّ ذلك عبر النقاشات والمحادثات غير الرسمية، أو الرسمية، أو الاجتماعات، أو من خلال نظم إدارة المعارف والمعرفة.

الخلفية العامة

- الجنس

قم باختيار إجابة واحدة فقط

- ذكر
- أنثى
- لا أرغب في ذكر ذلك

- العمر

قم باختيار إجابة واحدة فقط

- 25-16
- 35-26
- 45-36
- 55-46
- 56 وما فوق

- الخبرة (عدد السنين في المصلحة)

قم باختيار إجابة واحدة فقط

- 4-0
- 9-5
- 14-10
- 19-15
- 24-20
- 29-25
- 30 وما فوق

- التعليم

قم باختيار إجابة واحدة فقط

- ◯ ابتدائي
- ◯ متوسط
- ◯ ثانوي
- ◯ مهني
- ◯ بكالوريوس (جامعة)

غيره...........................

رجاءً اختر إجابة واحدة فقط: 1: لا أوافق إطلاقًا ، 2: لا أوافق، 3: محايد، 4: أوافق، 5: أوافق بشدّة

العلاقات المتبادلة المحتملة

مشاركتي للمعرفة تعزّز الروابط بيني وبين الأعضاء الحاليين في المشروع.

قم باختيار إجابة واحدة فقط

	1	2	3	4	5	
لا أوافق إطلاقًا	◯	◯	◯	◯	◯	أوافق بشدّة

إنّ مشاركتي للمعرفة تجعلني على قدر أكبر من المعرفة بالأعضاء الجدد في المشروع.

قم باختيار إجابة واحدة فقط

	1	2	3	4	5	
لا أوافق إطلاقًا	◯	◯	◯	◯	◯	أوافق بشدّة

إن مشاركتي للمعرفة تعزّز مجالات التعاون بيني وبين الأعضاء الآخرين في المشروع.

قم باختيار إجابة واحدة فقط

	1	2	3	4	5	
لا أوافق إطلاقًا	◯	◯	◯	◯	◯	أوافق بشدّة

إنّ مشاركتي للمعرفة تبني علاقات تعاون سلسة بيني وبين الأعضاء البارزين في المشروع.

قم باختيار إجابة واحدة فقط

	1	2	3	4	5	
لا أوافق إطلاقًا	◯	◯	◯	◯	◯	أوافق بشدّة

الشعور بقيمة الذات

إن مشاركتي للمعرفة تساعد الآخرين في المشروع على حلّ المشاكل.

قم باختيار إجابة واحدة فقط

	1	2	3	4	5	
لا أوافق إطلاقًا	◯	◯	◯	◯	◯	أوافق بشدّة

إنّ مشاركتي للمعرفة تساهم في تحسين العمل في المشروع.

قم باختيار إجابة واحدة فقط

	1	2	3	4	5	
لا أوافق إطلاقًا	◯	◯	◯	◯	◯	أوافق بشدّة

إن مشاركتي للمعرفة ترفع الإنتاجية في المشروع.

قم باختيار إجابة واحدة فقط

	1	2	3	4	5	
لا أوافق إطلاقًا	◯	◯	◯	◯	◯	أوافق بشدّة

إن مشاركتي للمعرفة تساعد المشروع في تحقيق أدائه المنشود.

قم باختيار إجابة واحدة فقط

	1	2	3	4	5	
لا أوافق إطلاقًا	◯	◯	◯	◯	◯	أوافق بشدّة

الارتباطات

الأعضاء في الفريق حيث أعمل يحافظون على علاقات وثيقة ببعضهم البعض.

قم باختيار إجابة واحدة فقط

	1	2	3	4	5	
لا أوافق إطلاقًا	◯	◯	◯	◯	◯	أوافق بشدّة

الأعضاء في الفريق حيث أعمل يراعون بشدّة وجهات نظر الأعضاء الآخرين.

قم باختيار إجابة واحدة فقط

	1	2	3	4	5	
لا أوافق إطلاقًا	◯	◯	◯	◯	◯	أوافق بشدّة

الأعضاء في الفريق حيث أعمل يتمتّعون بروحية "الفريق الواحد".

قم باختيار إجابة واحدة فقط

	1	2	3	4	5	
لا أوافق إطلاقًا	◯	◯	◯	◯	◯	أوافق بشدّة

الأعضاء في الفريق حيث أعمل يتعاونون بشكل جيّد جدًا مع بعضهم البعض.

قم باختيار إجابة واحدة فقط

	1	2	3	4	5	
لا أوافق إطلاقًا	◯	◯	◯	◯	◯	أوافق بشدّة

الإنصاف

أثق أنّ تقييم رئيسي في محّله.

قم باختيار إجابة واحدة فقط

	1	2	3	4	5	
لا أوافق إطلاقًا	◯	◯	◯	◯	◯	أوافق بشدّة

أعتبر أن الأهداف التي يُطلب منّي تحقيقها مقبولة وعقلانية.

قم باختيار إجابة واحدة فقط

	1	2	3	4	5	
لا أوافق إطلاقًا	◯	◯	◯	◯	◯	أوافق بشدّة

لا يظهر رئيسي تفضيله لأيّ كان على الآخر.

قم باختيار إجابة واحدة فقط

	1	2	3	4	5	
لا أوافق إطلاقًا	◯	◯	◯	◯	◯	أوافق بشدّة

الموقف من مشاركة المعرفة

أعتبر أنّي أشارك المعرفة بشكل جيّد مع غيري من الأعضاء في المشروع.

قم باختيار إجابة واحدة فقط

	1	2	3	4	5	
لا أوافق إطلاقًا	◯	◯	◯	◯	◯	أوافق بشدّة

أعتبر أنّ مشاركتي للمعرفة مع غيري من الأعضاء في المشروع مضرّة.

قم باختيار إجابة واحدة فقط

	1	2	3	4	5	
لا أوافق إطلاقًا	◯	◯	◯	◯	◯	أوافق بشدّة

أعتبر أن مشاركتي للمعرفة مع غيري من الأعضاء في المشروع تجربة ممتعة.

قم باختيار إجابة واحدة فقط

	1	2	3	4	5	
لا أوافق إطلاقًا	◯	◯	◯	◯	◯	أوافق بشدّة

إنّ مشاركتي للمعرفة مع غيري من أعضاء المشروع هو أمر ذو قيمة بالنسبة إليّ.

قم باختيار إجابة واحدة فقط

	1	2	3	4	5	
لا أوافق إطلاقًا	◯	◯	◯	◯	◯	أوافق بشدّة

أعتبر أنّه من الحكمة أن أشارك المعرفة مع غيري من الأعضاء في المشروع.

قم باختيار إجابة واحدة فقط

	1	2	3	4	5	
لا أوافق إطلاقًا	◯	◯	◯	◯	◯	أوافق بشدّة

المعيار الذاتي

المعتقدات السائدة حول مشاركة المعرفة

يعتقد رئيسي أنّه علّي مشاركة المعرفة مع غيري من الأعضاء في المشروع.

قم باختيار إجابة واحدة فقط

	1	2	3	4	5	
لا أوافق إطلاقًا	◯	◯	◯	◯	◯	أوافق بشدّة

يعتقد زملائي أنّه علّي مشاركة المعرفة مع غيري من الأعضاء في المشروع.

قم باختيار إجابة واحدة فقط

	1	2	3	4	5	
لا أوافق إطلاقًا	◯	◯	◯	◯	◯	أوافق بشدّة

حوافز الاستجابة

بشكل عام، أحاول اتّباع تعليمات رئيسي.

قم باختيار إجابة واحدة فقط

	1	2	3	4	5	
لا أوافق إطلاقًا						أوافق بشدّة

بشكل عام، أقبل وأنفّذ قرار رئيسي، حتى لو كان مختلفًا عن قراري.

قم باختيار إجابة واحدة فقط

	1	2	3	4	5	
لا أوافق إطلاقًا						أوافق بشدّة

بشكل عام، أحترم قرار زميلي وأضعه قيد التنفيذ.

قم باختيار إجابة واحدة فقط

	1	2	3	4	5	
لا أوافق إطلاقًا						أوافق بشدّة

النية في مشاركة المعرفة

الرغبة بمشاركة المعرفة الضمنية

أنوي مشاركة تجربتي وخبراتي من العمل بشكل أكبر مع أعضاء المشروع.

قم باختيار إجابة واحدة فقط

	1	2	3	4	5	
لا أوافق إطلاقًا						أوافق بشدّة

سأقوم دائمًا بتقديم معرفتي بمكامن و مالكي المعرفة عندما يطلبها أعضاء المشروع.

قم باختيار إجابة واحدة فقط

	1	2	3	4	5	
لا أوافق إطلاقًا						أوافق بشدّة

سأحاول مشاركة خبراتي التعلمية والتدريبية بشكل أكثر فعالية مع أعضاء المشروع.

قم باختيار إجابة واحدة فقط

	1	2	3	4	5	
لا أوافق إطلاقًا						أوافق بشدّة

Appendix B: Excel table with all the records

Red font indicates unusable record due to inconsistent answers
Red highlight indicates incomplete record

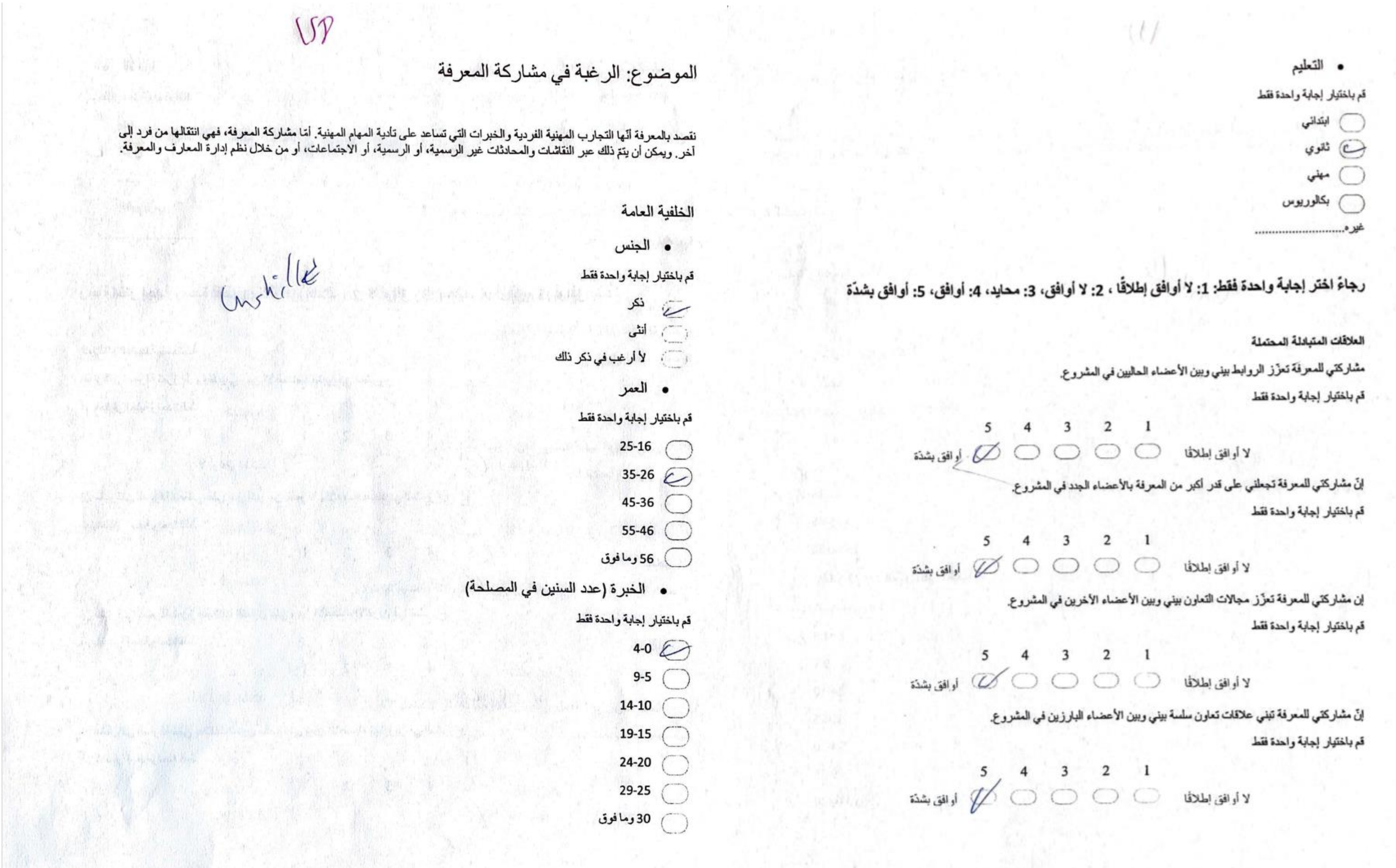
Survey ID	Site Number	Type of Construction	Gender	Age	Experience	Education	Position	ARR 1	ARR 2	ARR 3	ARR 4	SSW 1	SSW 2	SSW 3	SSW 4	Aff 1	Aff 2	Aff 3	Aff 4	Fair 1	Fair 2	Fair 3	Att 1	Att 2	Att 3	Att 4	Att 5	SN 1	SN 2	SN 3	SN 4	SN 5	Int 1	Int 2	Int 3
1	1		Male	16-25	5-9	Secondary	Skilled	3	5	5	5	5	3	4	3	3	5	5	5	3	5	3	4	1	5	5	5	5	3	5	3	5	5	5	5
2	1		Male	16-25	0-4	Secondary	Junior	5	5	5	5	5	5	5	5	5	4	4	4	4	4	3	4	1	4	4	5	4	5	4	4	4	4	4	4
3	1		Male	16-25	5-9	Technical	Junior	5	4	3	5	3	5	4	3	4	3	4	5	4	3	5	3	1	4	5	5	4	3	3	3	2	4	3	5
4	1		Male	36-45	0-4	Elementary	Junior	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	1	5	5	4	4	4	5	4	4	1	4	4
5	1		Male	26-35	10-14	not educated	Skilled	4	4	5	4	4	5	4	5	4	5	4	5	5	4	4	5	4	5	5	4	4	5	5	5	4	4	5	5
6	1		Male	26-35	0-4	Elementary	Junior	5	5	4	5	5	4	5	5	4	5	5	4	5	5	5	5	1	4	4	4	5	4	5	5	3	5	4	5
7	1	Renovation	Male	26-35	25-29	not educated	Skilled	4	4	4	4	3	5	5	5	4	3	3	3	3	1	5	3	1	3	5	5	4	4	4	5	5	5	5	4
8	1		Male	26-35	5-9	Secondary	Junior	4	4	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	4	5	5	5	4
9	1		Male	16-25	0-4	Technical	Junior	5	4	4	4	4	4	2	4	4	5	5	4	1	3	5	4	5	4	1	1	1	3	5	5	1	4	2	5
10	1		Male	16-25	0-4	Technical	Junior	3	5	4	3	5	4	5	5	4	5	5	5	5	3	4	5	4	2	5	5	5	5	5	5	5	4	4	3
11	1		Male	16-25	5-9	Elementary	Junior	4	4	2	2	5	3	4	4	3	4	5	4	5	4	2	4	2	4	5	3	4	4	5	2	3	4	4	4
12	1		Male	16-25	5-9	Elementary	Skilled	4	3	4	4	4	4	4	4	1	5	5	4	4	5	4	4	2	4	4	4	4	4	5	1	3	4	5	4
13	1		Male	36-45	15-19	Secondary	Junior	5	5	5	3	5	5	5	4	3	3	2	2	3	3	2	4	2	4	4	4	3	4	5	1	3	4	2	4
14	2		Male	16-25	0-4	Elementary	Skilled	4	5	4	4	4	2	4	3	2	2	2	4	4	4	2	2	4	3	3	5	2	4	2	3	4	2	4	2
15	2		Male	26-35	0-4	Bachelors	Skilled	5	5	4	5	5	5	5	5	5	1	5	5	4	3	3	2	5	4	4	4	5	4	5	1	3	5	4	5
16	2		Male	26-35	10-14	Elementary	Skilled	5	2	5	5	5	4	4	4	3	4	4	4	5	1	1	4	1	5	4	4	4	4	4	1	3	5	5	5
17	2		Male	16-25	5-9	Technical	Skilled	5	5	3	5	5	4	5	5	4	2	3	3	5	5	1	5	1	5	5	5	5	5	5	4	3	5	5	5
18	2		Male	26-35	5-9	Secondary	Skilled	4	3	5	4	5	4	3	3	5	5	5	5	4	4	5	1	4	4	4	5	5	2	5	3	5	5	5	5
19	2		Male	26-35	5-9	Secondary	Skilled	5	5	5	4	4	4	5	5	5	5	3	3	1	1	1	3	1	1	1	3	1	1	5	5	5	5	5	5
20	2	Renovation	Male	26-35	0-4	Bachelors	Junior	5	4	5	3	5	5	5	4	5	4	5	4	1	4	1	3	1	5	4	5	1	2	4	4	4	4	5	5
21	2		Male	26-35	0-4	Middle	Junior	5	5	5	4	5	5	5	5	5	5	5	5	5	5	4	4	1	4	5	5	5	5	5	5	4	5	5	5
22	2		Male	16-25	0-4	Secondary	Junior	5	5	5	5	5	5	5	5	5	5	4	4	5	4	5	5	2	4	4	4	4	4	4	3	4	4	4	4
23	2		Male	26-35	0-4	Elementary	Junior	5	5	5	4	4	5	5	5	5	5	5	5	5	4	4	4	1	5	4	4	4	4	5	4	4	4	4	4
24	2		Male	16-25	0-4	Elementary	Skilled	4	5	5	5	4	4	4	4	2	4	5	3	3	3	5	4	4	4	2	4	4	3	4	5	3	4	4	4
25	2		Male	16-25	0-4	Bachelors	Junior	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	1	2	2	5	5	5	5	5	5	5	5	5
26	2		Male	36-45	5-9	Secondary	Junior	2	1	3	3	2	5	5	5	5	5	5	5	5	5	5	5	3	1	1	1	2	3	1	1	1	2	2	2
27	2		Male	26-35	5-9	Bachelors	Junior	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	1	5	5	5	5	5	5	5	5	5	5	5
28	2		Male	26-35	0-4	Technical	Junior	4	4	4	4	4	4	4	4	4	4	4	4	5	4	4	4	2	4	4	3	4	4	4	4	5	5	5	5
29	3		Male	26-35	15-19	Elementary	Skilled	5	5	5	5	4	4	5	5	5	4	3	4	3	4	1	5	1	5	5	5	3	3	5	5	1	5	5	5
30	3		Male	16-25	0-4	not educated	Junior	4	4	5	5	5	4	5	4	4	4	5	5	5	5	4	5	1	5	5	5	5	4	5	5	4	5	5	5
31	3		Male	16-25	0-4	not educated	Junior	1	4	4	4	4	4	4	4	3	1	4	2	4	4	2	4	4	4	1	4	3	4	4	2	3	2	2	4
32	3	New	Male	16-25	0-4	not educated	Junior	4	4	4	4	2	4	4	4	4	4	4	4	4	4	4								4	4	4	4	4	4
33	3		Male	16-25	10-14	Secondary	Skilled	3	5	4	2	5	5	5	5	5	5	5	4	2	3	2	5	1	3	4	4	4	4	4	3	4	5	4	5
34	3		Male	26-35	10-14	Secondary	Skilled	5	4	4	5	5	5	4	3	3	3	4	4	3	4	4	5	1	3	5	4	4	3	5	3	2	4	5	4
35	3		Male	26-35	5-9	Elementary	Skilled	4	4	4	3	4	4	4	4	4	4	4	2	3	3	1	4	3	4	4	4	4	4	4	4	4	4	4	4

Survey ID	Site Number	Type of Construction	Gender	Age	Experience	Education	Position	ARR 1	ARR 2	ARR 3	ARR 4	SSW 1	SSW 2	SSW 3	SSW 4	Aff 1	Aff 2	Aff 3	Aff 4	Fair 1	Fair 2	Fair 3	Att 1	Att 2	Att 3	Att 4	Att 5	SN 1	SN 2	SN 3	SN 4	SN 5	Int 1	Int 2	Int 3
36	4		Male	36-45	25-29	Elementary	Foreman	5	5	5	5	4	4	5	5	4	4	5	4	3	3	1	5	2	4	5	5	3	5	4	3	5	5	5	5
37	4		Male	16-25	0-4	Middle	Junior	4	4	5	4	5	5	5	5	5	5	5	5	4	5	5	4	3	5	5	4	5	4	5	4	3	4	3	4
38	4		Male	36-45	30+	Elementary	Junior	5	5	5	5	5	5	4	4	5	3	4	4	5	5	5	5	2	5	5	5	5	5	5	5	4	5	5	5
39	4		Male	36-45	20-24	Elementary	Skilled	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	1	5	5	5	5	4	5	1	4	5	4	5
40	4	New	Male	16-25	5-9	not educate	Skilled	5	5	5	5	5	5	5	5	2	2	2	4	4	3	4	3	1	4	5	4	2	3	4	3	3	4	4	4
41	4		Male	26-35	10-14	not educate	Skilled	5	5	5	5	5	5	5	4	5	5	4	5	5	4	5	4	1	5	5	5	4	4	3	5	4	5	5	4
42	4		Male	26-35	10-14	Secondary	Foreman	4	5	4	4	4	4	5	5	4	4	4	4	4	4	4	4	1	3	4	4	4	4	4	2	4	5	5	5
43	4		Male	36-45	10-14	Elementary	Skilled	4	4	4	4	4	4	4	4	4	4	4	4	4	4	1	4	1	4	4	4	4	4	4	3	3	4	4	4
44	4		Male	26-35	10-14	Elementary	Skilled	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	1	3	3	5	5	5	5	5	5	5	5	5
45	4		Male	26-35	5-9	Elementary	Junior	5	5	4	4	5	5	5	5	4	5	5	5	3	4	4	4	1	4	5	5	5	5	5	2	4	4	5	5
46	5		Prefer n	16-25	0-4	Secondary	Junior	5	4	5	5	4	5	5	5	5	4	3	4	5	4	3	4	1	5	4	5	4	4	5	4	3	5	5	5
47	5		Male	26-35	0-4	Bachelors	Skilled	5	5	5	5	5	5	5	5	5	5	5	5	5	5	3	5	5	5	4	5	5	5	5	5	4	5	5	5
48	5		Male	56+	5-9		Skilled	4	4	4	4	4	5	5	4	4	4	4	4	4	4	4	4	2	4	4	4	4	4	4	4	4	4	4	4
49	5		Male	26-35	5-9	Elementary	Skilled	5	5	5	5	5	5	5	5	5	5	5	5	5	4	4	4	4	4	5	5	4	5	5	4	4	4	5	4
50	5		Prefer n	16-25	0-4	Technical	Skilled	3	4	4	4	4	5	4	4	4	2	3	4	4	4	2	4	1	4	4	4	3	4	5	5	4	5	3	5
51	5		Male	26-35	0-4	Bachelors	Skilled	1	2	5	1	4	4	5	5	5	4	3	5	5	5	2	5	1	5	5	5	3	5	5	5	5	5	5	5
52	5		Male	16-25	5-9	Bachelors	Junior	5	5	5	5	5	5	5	5	5	5	5	5	3	4	4	4	1	4	5	5	5	4	5	3	4	5	5	5
53	5		Male	16-25	0-4	Secondary	Skilled	4	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	1	5	5	5	5	5	5	5	5	5	5	5
54	5		Male	26-35	5-9	Secondary	Junior	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	2	5	5	3	4	4	5	5	5	5	5	5
55	5		Male	16-25	0-4	Secondary	Junior	5	5	4	4	4	5	4	5	5	4	1	5	5	5	1	4	2	2	5	4	4	5	5	5	5	5	5	5
56	5		Male	26-35	5-9	Bachelors	Skilled	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	1	5	5	5	5	5	5	5	5	5	5	5
57	5		Male	26-35	10-14	Technical	Skilled	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	3	5	5	5	5	5	5	3	5	5	5	5
58	5		Male	26-35	5-9	Secondary	Skilled	5	4	4	5	5	4	4	4	3	4	5	5	5	4	5	5	3	3	4	4	3	4	3	3	4	3	3	3
59	6		Male	36-45	0-4	Middle	Junior	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	1	4	4	4	4	4	4	2	4	4	4	4
60	6		Male	16-25	0-4	Secondary	Junior	4	4	3	4	3	4	4	5	2	4	3	5	3	4	1	3	2	5	5	5	4	5	5	2	4	5	5	5
61	6		Male	36-45	20-24	Secondary	Foreman	5	5	5	5	5	5	5	5	4	4	4	4	5	4	2	2	1	5	5	5	4	5	5	3	5	5	5	5
62	6		Male	26-35	5-9	Technical	Skilled	2	3	4	5	5	5	5	5	4	5	4	5	4	5	1	4	1	5	5	5	4	5	5	4	4	4	4	5
63	6		Male	16-25	0-4	not educate	Junior	4	4	3	4	4	5	5	5	4	5	5	5	2	4	1	4	1	5	5	5	5	5	5	2	2	5	5	5
64	6		Male	16-25	0-4	Secondary	Junior	5	4	5	5	5	5	5	5	2	4	5	4	5	3	2	4	1	5	5	5	4	5	5	5	4	4	5	4
65	6		Male	26-35	10-14	Middle	Skilled	2	2	4	4	4	4	4	5	5	4	5	5	5	5	5	4	1	5	5	5	5	5	4	5	5	5	5	5
66	6		Male	26-35	10-14	Technical	Junior	4	5	5	5	5	5	5	5	5	5	4	5	3	4	3	5	3	3	3	5	3	5	4	3	5	3	5	5
67	6	New	Male	36-45	20-24	Secondary	Foreman	5	5	5	5	3	5	5	5	4	4	4	3	5	3	3	5	1	5	5	5	5	5	5	4	5	5	5	5
68	6		Male	36-45	10-14	Elementary	Foreman	5	1	4	5	5	4	5	5	4	3	4	4	4	4	5	5	1	5	5	5	5	5	5	1	3	5	4	5
69	6		Male	36-45	20-24	Secondary	Skilled	5	5	5	5	5	5	5	5	3	2	5	5	5	1	5	5	1	4	5	5	5	5	5	1	3	5	5	5
70	6		Male	26-35	0-4	Secondary	Junior	5	5	5	5	5	4	5	4	4	5	5	5	5	5	5	5	1	5	5	5	4	5	5	4	5	5	5	5
71	6		Male	26-35	5-9	Technical	Skilled	5	4	4	5	5	5	5	5	5	5	5	5	5	4	5	5	1	5	4	5	5	5	5	3	3	5	5	4
72	6		Male	26-35	15-19	Elementary	Junior	5	5	5	5	3	4	5	5	2	1	3	5	1	3	1	5	1	5	5	5	1	5	5	1	3	5	5	5
73	6		Male	36-45	5-9	Secondary	Skilled	5	5	5	5	5	5	5	5	3	3	5	5	5	3	5	5	1	5	5	5	5	5	5	1	3	5	5	5
74	6		Male	16-25	0-4	Elementary	Junior	5	4	4	5	4	5	5	5	5	4	4	4	3	3	1	5	1	5	4	4	5	5	5	1	3	5	5	5
75	6		Male	36-45	20-24	Elementary	Foreman	4	5	3	5	5	5	5	5	4	4	4	4	4	4	3	4	1	4	4	4	4	4	4	1	4	4	4	3
76	7		Male	46-55	30+	Secondary	Foreman	5	5	4	5	5	5	5	5	4	3	3	3	5	4	5	5	1	4	5	5	5	5	5	5	5	5	5	5
77	7		Male	16-25	0-4	Middle	Junior	3	5	3	2	5	5	3	4	5	3	5	5	4	5	3	5	1	5	4	5	5	5	4	5	5	5	5	5
78	7		Male	26-35	5-9	Secondary	Skilled	3	5	4	5	4	5	5	5	5	4	5	5	5	5	4	5	3	5	5	4	5	5	5	4	5	5	5	5
79	7		Male	16-25	0-4	Elementary	Junior	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	5	5	4	5	5	5	5	5	5	5

Survey ID	Site Number	Type of Construction	Gender	Age	Experience	Education	Position	ARR 1	ARR 2	ARR 3	ARR 4	SSW 1	SSW 2	SSW 3	SSW 4	Aff 1	Aff 2	Aff 3	Aff 4	Fair 1	Fair 2	Fair 3	Att 1	Att 2	Att 3	Att 4	Att 5	SN 1	SN 2	SN 3	SN 4	SN 5	Int 1	Int 2	Int 3
79	7		Male	16-25	0-4	Elementary	Junior	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	5	5	4	5	5	5	5	5	5	5
80	7		Male	16-25	0-4	Elementary	Junior	4	4	3	4	4	4	4	4	3	3	3	3	3	3	3	3	3	4	4	3	3	3	4	4	3	3	4	4
81	7		Male	16-25	0-4	Elementary	Junior	5	5	4	3	5	5	5	5	4	5	3	5	5	5	3	5	3	5	5	4	5	5	5	5	5	5	5	5
82	7		Male	16-25	0-4	Elementary	Junior	4	4	4	4	4	5	5	5	4	4	5	5	5		5	4	4	4	5	4	5	3	5	5	5	5	5	5
83	7		Male	36-45	5-9	Elementary	Skilled	4	4	4	4	4	4	4	4	1	3	4	4	4	4	2	4	2	4	4	4	4	2	4	4	3	2	4	4
84	7		Male	16-25	5-9	Bachelors	Junior	5	5	3	3	3	5	5	3	5	5	5	5	3	3	3	3	1	3	5	3	3	5	5	5	5	5	5	5
85	7		Prefer n	16-25	0-4	Secondary	Skilled	2	4	4	4	4	4	4	4	4	4	4	3	4	3	4	4	3	4	3	4	3	4	4	2	4	4	3	4
86	8		Male	16-25	5-9	Elementary	Junior	3	5	5	5	5	5	5	5	5	5	5	5	5	2	1	5	1	5	5	5	5	5	5	3	5	5	5	5
87	8		Male	26-35	10-14	Technical	Foreman	5	5	5	5	5	5	5	5	5	5	5	5	5	4	5	5	1	5	5	5	5	5	5	3	3	5	5	5
88	8		Male	36-45	15-19	Elementary	Skilled	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
89	8		Male	26-35	5-9	Elementary	Junior	4	5	5	5	5	5	5	5	5	5	5	5	5	4	4	5	5	5	5	5	5	5		5	5	5	5	5
90	8		Male	16-25	0-4	Secondary	Junior	5	5	5	5	5	5	4	5	5	4	5	5	1	4	4	5	1	5	5	5	4	5	1	4	5	5	5	5
91	8	New	Male	16-25	0-4	Elementary	Junior	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	1	5	5	5	5	5
92	8		Male	26-35	5-9	Middle	Skilled	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	1	5	5	4	5	5	5	5	5	5	5	5
93	8		Male	36-45	5-9	Middle	Skilled	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	1	5	5	5	5	5	5	5	5	5	5	5
94	8		Male	26-35	10-14	Secondary	Skilled	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	4	1	4	4	4	4	4	5	4	3			
95	8		Male	16-25	0-4	not educated	Junior	4	4	4	4	5	5	5	5	5	4	4	4	5	5	4	5	1	5	5	5	5	5	5	5	5	4	5	5
96	8		Male	26-35	10-14	Elementary	Junior	5	5	5	5	5	5	5	5	5	5	4	4	4	4	4	4	1	4	4	4	4	4	5	4	4	4	4	4
97	8		Male	26-35	10-14	Elementary	Junior	5	4	5	5	5	5	5	5	5	4	5	5	4	4	5	5	1	5	5	5	5	4	5	5	5	5	5	5
98	9		Male	16-25	10-14	Secondary	Junior	1	2	1	1	1	2	3	2	1	1	3	3	5	3	5	5	1	5	5	5	5	5	5	1	3	5	4	4
99	9		Male	26-35	10-14	Secondary	Skilled	5	4	4	4	4	4		5	5	5	4		2	4	4	4	1	4	4	3	4	1	4	5	4	4	5	4
100	9		Male	26-35	10-14	Bachelors	Skilled	2	2	2	3	3	4	4	4	3	3	3	3	4	4	5	4	1	2	3	3	3	3	4	4	3	3	3	3
101	9		Male	16-25	5-9	Elementary	Skilled	4	4		5	5	4	4	4	5	4	4	5		4	5	4	4	4	4	4	4	4	4	4	3	4	4	4
102	9		Male	26-35	10-14	Secondary	Skilled	5	5	5	4	5	5	5	5	4	3	4	5	3	4	5	5	1	5	5	4	4	3						
103	9		Male	36-45	15-19	Secondary		4	4	4	4	4	5	5	5	4	4	5	5	5	5	4	5	4	4	4	4	4	4	4	1	4	4	4	4
104	9		Male	16-25	0-4	Secondary	Junior	5	5	5	5	5	5	5	5	5	2	2	3	4	4	1	4	1	4	5	5	3	3	4	4	4	5	5	5
105	9		Male	26-35	5-9	Elementary	Junior	4	4	4	4	5	3	3	3	3	2	2	3	3	3	1	3	2	3	3	3	4	4	4	4	4	3	3	3
106	9		Male	16-25	0-4	Secondary	Junior	5	3	4	5	4	4	4	4	5	5	5	5	4	5	4	5	1	4	5	5	4	4	5	4	4	5	5	5
107	9		Male	16-25	0-4	Elementary	Junior	5	5	5	5	5	5	5	5	5	5	3	4	5	4	4	5	1	4	5	4	4	3	5	5	3	5	4	4
108	9		Male	16-25	5-9	Elementary	Junior	4	5	3	5	5	5	5	5	2	4	2	4	4	3	2	5	1	5	5	5	5	4	5	4	5	5	4	2
109	10		Male	46-55	30+	Elementary	Junior	5	4	4	3	4	4	3	4	2	2	3	2	4	5	4	4	2	3	3	4	5	5	4	4	2	3	4	4
110	10		Male	26-35	10-14	not educated	Junior	3	2	2	3	3	4	4	4	2	2	2	2	5	4	3	4	1	2	3	4	5	4	4	5	3	4	4	5
111	10		Male	36-45	15-19	Technical	Skilled	4	5	5	4	4	4	4	4	2	3	4	4	4	5	3	5	1	5	4	4	4	3	4	5	3	5	5	5
112	10		Male	46-55	30+	Elementary	Skilled	4	4	5	4	5	4	5	4	3	3	3	4	2	3	2	4	1	4	4	5	4	4	3	3	2	4	5	5
113	10	New	Male	16-25	0-4	Elementary	Junior	3	4	3	4	3	3	4	4	4	4	4	4	4	5	5	5	1	4	4	5	3	4	3	2	2	4	5	5
114	10		Male	26-35	10-14	Secondary	Skilled	5	5	5	5	4	4	5	4	4	4	3	2	4	5	3	4	1	4	4	5	4	5	3	2	2	4	4	5
115	10		Male	46-55	30+	Secondary	Skilled	5	5	4	4	4	5	5	4	4	4	5	5	5	5	5	5	1	5	5	5	5	3	3	4	2	5	5	5
116	10		Male	16-25	0-4	not educated	Junior	3	4	3	4	3	3	4	4	3	4	3	2	5	5	5	4	3	4	3	4	4	4	4	5	3	4	4	4
117	10		Male	36-45	25-29	Secondary	Skilled	4	4	4	4	5	4	4	5	4	3	4	4	5	5	4	5	1	3	3	4	4	4	3	4	2	4	5	5
118	10		Male	16-25	5-9	Elementary	Junior	3	2	2	3	3	3	3	2	2	1	3	4	4	3	2	4	3	2	3	3	4	3	4	4	2	4	4	4
119	11		Male	16-25	5-9	Secondary	Skilled	3	3	1	1	2	5	3	4	4	1	1	1	4	5	3	5	1	1	1	5	4	3	2	5	4	5	5	5
120	11		Male	16-25	0-4	Secondary	Junior	5	4	5	5	4		4	5	5	4	3	5	5	5	4	5	5	5	5	3	5	4	5	3	5	4	5	5
121	11		Male	46-55	15-19	Secondary	Skilled	5	4	4	4	5	5	5	5	4	4	3	3	3	4	3	4	1	5	5	5	5	4	5	5	3	5	5	5
122	11		Male	26-35	5-9	Technical	Skilled	5	4	5	5	5	4	5	5	5	5	5	5	5	5	5	3	1	5	3	1	5	5	5	3	3	5	5	5

Survey ID	Site Number	Type of Construction	Gender	Age	Experience	Education	Position	ARR 1	ARR 2	ARR 3	ARR 4	SSW 1	SSW 2	SSW 3	SSW 4	Aff 1	Aff 2	Aff 3	Aff 4	Fair 1	Fair 2	Fair 3	Att 1	Att 2	Att 3	Att 4	Att 5	SN 1	SN 2	SN 3	SN 4	SN 5	Int 1	Int 2	Int 3
122	11		Male	26-35	5-9	Technical	Skilled	5	4	5	5	5	4	5	5	5	5	5	5	5	5	5	3	1	5	3	1	5	5	5	3	3	5	5	5
123	11		Male	16-25	5-9	Elementary	Skilled	3	4	5	5	5	5	5	5	4	5	5	5	5	4	5	4	4	4	5	5	4	5	5	3	4	5	5	5
124	11		Male	16-25	5-9	Secondary	Junior	2	1	2	1	5	4	5	4	3	5	5	3	3	5	5	4	2	3	5	5	4	4	5	5	4	5	4	5
125	11	New	Male	26-35	0-4	Elementary	Skilled	2	1	2	3	3	2	2	4	5	4	5	5	5	4	5	1	4	5	4	4	4	5	5	4	4	4	3	4
126	11		Male	26-35	5-9	Bachelors	Skilled	5	3	3	5	5	5	2	1	2	1	2	2	4	3	5	4	3	5	5	4	4	3	5	4	3	3	5	4
127	11		Male	26-35	10-14	Technical	Skilled	5	5	4	3	5	5	5	5	5	5	5	5	5	5	5	5	1	5	5	5	5	5	5	5	5	5	5	5
128	11		Male	16-25	5-9	Technical	Skilled	1	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	1	5	5	5	5	5	5	3	5	5	5	5
129	11		Male	16-25	0-4	Middle	Junior	4	4	5	4	4	3	5	1	4	4	5	3	3	3	2	4	1	4	3	4	4	5	5	3		4	4	4
130	11		Male	16-25	5-9	Bachelors	Skilled	4	5	5	4	5	5	4	5	4	3	3	5	5	1	5	2	5	5	5	5	5	5	5	4	1	5	4	5
131	11		Male	16-25	0-4	Middle	Junior	4	4	5	4	5	5	5	5	4	3	5	5	5	4	5	5	1	5	5	5	4	4	5	1	3	3	4	5
132	11		Male	36-45	10-14	Secondary	Foreman	5	3	5	5	5	5	5	5	5	5	5	5	5	5	5	5	1	5	5	5	5	5	5	1	5	5	5	5
133	12		Male	46-55	30+	Middle	Foreman	5	5	5	5	4	3	5	3	3	5	3	4	5	5	3	5	1	5	5	5	5	2	5	3	4	5	5	5
134	12		Male	36-45	25-29	Elementary	Skilled	5	5	5	3	5	5	5	5	5	2	4	5	4	5	5	4	3	5	5	5	5	3	5	3	3	5	5	5
135	12	New	Male	16-25	0-4	Middle	Junior	5	5	5	5	2	5	5	5	5	5	5	5	5	5	1	5	1	5	5	5	5	5	5	2	4	5	5	5
136	12		Male	36-45	25-29	Middle	Foreman	5	4	5	4	5	5	5	5	5	5	5	5	3	5	1	4	1	5	5	5	5	5	5	3	3	5	5	5
137	12		Male	36-45	5-9	Middle	Junior	5	5	5	5	5	5	5	5	3	4	4	5	4	3	2	5	1	5	5	5	2	5	5	4	4	5	4	5
138	13		Male	36-45	20-24	Elementary	Foreman	4	5	4	4	5	5	5	5	4	4	5	5	4	4	1	5	1	5	4	4	3	5	5	5	4	4	4	4
139	13		Male	26-35	5-9	Elementary	Junior	5	5	5	5	5	5	5	5	5	5	5	5	5	5	1	4	1	5	5	5	5	5	5	5	3	5	5	5
140	13		Male	36-45	0-4	not educated	Junior	5	5	5	5	4	5	5	5	1	1	3	4	4	4	1	4	1	5	5	5	5	5	5	4	3	5	5	5
141	13		Male	46-55	30+	not educated	Skilled	4	5	4	3	4	4	4	5	5	4	5	4	5	5	1	5	1	5	5	5	5	5	5	4	3	4	5	3
142	13	New	Male	26-35	10-14	Elementary	Foreman	5	5	5	4	5	4	4	4	3	4	3	4	4	4	1	4	1	5	5	5	3	4	5	4	5	4	3	4
143	13		Male	26-35	10-14	Bachelors	Foreman	5	4	5	5	5	5	5	5	3	3	4	4	5	5	1	3	1	5	5	3	3	5	5	2	3	2	2	3
144	13		Male	46-55	15-19	Technical	Foreman	4	4	5	5	5	5	5	5	5	5	5	4	5	5	5	5	1	4	5	5	5	5	4	3	4	4	5	5
145	13		Male	36-45	25-29	Elementary	Foreman	5	5	5	5	5	5	5	5	3	5	3	5	5	4	1	5	2	5	5	5	5	5	5	3	5	5	5	5
146	13		Male	36-45	10-14	Elementary	Skilled	5	4	5	5	5	5	5	5	4	5	5	5	5	5	3	5	1	5	5	5	5	5	5	3	2	5	5	5
147	14		Male	26-35	0-4	Secondary	Skilled	5	5	5	5	5	5	5	5	4	4	5	5	5	5	5	5	4	5	5	5	5	5	5	5	4	5	5	5
148	14		Male	26-35	5-9	Secondary	Junior	5	5	5	4	4	5	4	5	5	4	5	5	4	4	3	4	1	4	4	5	3	3	5	4	4	5	5	4
149	14		Male	16-25	0-4	Secondary	Junior	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	1	4	5	5	5	5	5	5	5	5	5	5
150	14	New	Male	36-45	10-14	Elementary	Skilled	5	5	5	5	5	5	5	5	5	5	4	4	3	4	5	5	5	4	3	5	5	5	5	5	5	5	4	5
151	14		Male	16-25	0-4	not educated	Junior	4	4	4	4	2	2	3	2	3	2	5	4	4	3	1	4	1	4	4	4	4	4	4	4	4	4	4	4
152	14		Male	16-25	5-9	Bachelors	Skilled	4	5	5	4	5	5	5	3	5	5	5	4	3	5	5	5	1	5	5	3	5	3	1	1	4	5	5	5
153	14		Male	26-35	10-14	Secondary	Junior	4	5	5	3	5	5	5	5	5	5	5	4	5	5	4	4	1	5	5	5	5	3	5	2	4	4	4	5
154	15		Male	26-35	10-14	Elementary	Skilled	4	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5							5	3	5	5	5	5
155	15		Male	36-45	10-14		Foreman					5	5	5	5	5	5							1	5	5	5	5	3	5	4	3	5	5	5
156	15		Male	26-35	20-24	Elementary	Skilled	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	1	5	5	5	5	5	5	3	5	5	5	5
157	15		Male	56+	15-19	Middle	Junior	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	4	1	4	4	4	4	4	5	4	4	5	5	5
158	15		Male	26-35	0-4	Secondary	Junior	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	1	5	5	5	5	5	5	5	5	5	5	5
159	15	Renovation	Male	36-45	10-14	Elementary	Junior	5	5	5	5	3	5	5	4	5	4	4	5	5	5	5	4	1	5	5	5	5	5	5	3	4	5	5	5
160	15		Male	16-25	5-9	Elementary	Junior	5	5	5	5	5	5	5	5	5	5	5	5	5	5	1	5	1	5	5	5	5	5	5	3	5	5	5	5
161	15		Male	26-35	20-24	Elementary	Skilled	5	5	5	5	5	5	5	5	3	5	5	5	3	5	5	5	1	5	5	5	5	5	5	3	5	5	5	5
162	15		Male	16-25	0-4	not educated	Junior	4	3	4	2	2	4	4	4	3	4	2	4	3	4	5	4	1	4	4	4	3	4	4	4	4	4	4	5
163	15		Male	26-35	5-9	Bachelors	Skilled	5	4	5	4	5	5	5	4	4	5	4	3	5	3	4	5	1	3	4	3	1	5	5	1	4	3	4	5
164	15		Male	26-35	5-9	Secondary	Skilled	4	4	4	4	4	4	4	5	5	5	4	4	5	5	4	4	4	5	5	4	4	5	5	4	4	4	4	4
165	15		Male	26-35	0-4	Middle	Junior	4	3	4	4	4	4	4	4	3	2	4	4	4	4	3	4	1	4	4	4	4	4	4	4	4	4	4	4
166	16		Male	16-25	5-9	Elementary	Foreman	4	4	4	4	4	4	4	4	4	2	4	5	5	5	5	5	1	5	5	5	5	5	5	1	4	5	5	5
167	16		Male	16-25	10-14	Elementary	Junior	5	5	5	5	2	5	5	5	1	1	5	5	5	1	5	5	1	5	5	5	5	5	5	5	5	5	5	5
168	16	Renovation	Male	26-35	0-4	Elementary	Junior	4	5	4	5	5	5	5	5	5	5	5	5	5	5	5	2	1	5	5	3	4	4	4	4	4	5	5	5
169	16		Male	16-25	5-9	Secondary	Skilled	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	1	5	5	5	4	4	5	3	3	5	5	5
170	16		Male	16-25	0-4	Elementary	Junior	5	5	5	5	4	4	4	5	4	4	5	5	4	2	5	4	1	5	5	5	3	4	5	4	5	4	5	5
171	16		Male	16-25	5-9	Bachelors	Foreman	5	4	5	5	5	5	5	5	5	5	5	5	5	5	5	5	1	5	5	5	5	5	5	3	5	5	5	5

Appendix C: Survey sample



الموضوع: الرغبة في مشاركة المعرفة

نقصد بالمعرفة أنّها التجارب المهنية الفردية والخبرات التي تساعد على تأدية المهام المهنية. أمّا مشاركة المعرفة، فهي انتقالها من فرد إلى آخر. ويمكن أن يتمّ ذلك عبر النقاشات والمحادثات غير الرسمية، أو الرسمية، أو الاجتماعات، أو من خلال نظم إدارة المعارف والمعرفة.

الخلفية العامة

- الجنس

قم باختيار إجابة واحدة فقط

ذكر

أنثى

لا أرغب في ذكر ذلك

- العمر

قم باختيار إجابة واحدة فقط

25-16

35-26

45-36

55-46

56 وما فوق

- الخبرة (عدد السنين في المصلحة)

قم باختيار إجابة واحدة فقط

4-0

9-5

14-10

19-15

24-20

29-25

30 وما فوق

- التعليم

قم باختيار إجابة واحدة فقط

ابتدائي

ثانوي

مهني

بكالوريوس

غيره..............................

رجاءً اختر إجابة واحدة فقط: 1: لا أوافق إطلاقًا ، 2: لا أوافق، 3: محايد، 4: أوافق، 5: أوافق بشدّة

العلاقات المتبادلة المحتملة

مشاركتي للمعرفة تعزّز الروابط بيني وبين الأعضاء الحاليين في المشروع.

قم باختيار إجابة واحدة فقط

1 2 3 4 5

لا أوافق إطلاقًا — أوافق بشدّة

إنّ مشاركتي للمعرفة تجعلني على قدر أكبر من المعرفة بالأعضاء الجدد في المشروع.

قم باختيار إجابة واحدة فقط

1 2 3 4 5

لا أوافق إطلاقًا — أوافق بشدّة

إن مشاركتي للمعرفة تعزّز مجالات التعاون بيني وبين الأعضاء الأخرين في المشروع.

قم باختيار إجابة واحدة فقط

1 2 3 4 5

لا أوافق إطلاقًا — أوافق بشدّة

إنّ مشاركتي للمعرفة تبني علاقات تعاون سلسة بيني وبين الأعضاء البارزين في المشروع.

قم باختيار إجابة واحدة فقط

1 2 3 4 5

لا أوافق إطلاقًا — أوافق بشدّة

الشعور بقيمة الذات

إن مشاركتي للمعرفة تساعد الآخرين في المشروع على حلّ المشاكل.

قم باختيار إجابة واحدة فقط

لا أوافق إطلاقًا	1	2	3	4	5	أوافق بشدة

إنّ مشاركتي للمعرفة تساهم في تحسين العمل في المشروع.

قم باختيار إجابة واحدة فقط

لا أوافق إطلاقًا	1	2	3	4	5	أوافق بشدة

إن مشاركتي للمعرفة ترفع الإنتاجية في المشروع.

قم باختيار إجابة واحدة فقط

لا أوافق إطلاقًا	1	2	3	4	5	أوافق بشدة

إن مشاركتي للمعرفة تساعد المشروع في تحقيق أدائه المنشود.

قم باختيار إجابة واحدة فقط

لا أوافق إطلاقًا	1	2	3	4	5	أوافق بشدة

الارتباطات

الأعضاء في الفريق حيث أعمل يحافظون على علاقات وثيقة ببعضهم البعض.

قم باختيار إجابة واحدة فقط

لا أوافق إطلاقًا	1	2	3	4	5	أوافق بشدة

الأعضاء في الفريق حيث أعمل يراعون بشدّة وجهات نظر الأعضاء الآخرين.

قم باختيار إجابة واحدة فقط

لا أوافق إطلاقًا	1	2	3	4	5	أوافق بشدة

الأعضاء في الفريق حيث يتمتّعون أعمل بروحية "الفريق الواحد".

قم باختيار إجابة واحدة فقط

لا أوافق إطلاقًا	1	2	3	4	5	أوافق بشدة

الأعضاء في الفريق حيث أعمل يتعاونون بشكل جيّد جدًا مع بعضهم البعض.

قم باختيار إجابة واحدة فقط

لا أوافق إطلاقًا	1	2	3	4	5	أوافق بشدة

الإنصاف

أثق أنّ تقييم رئيسي في محله.

قم باختيار إجابة واحدة فقط

لا أوافق إطلاقًا	1	2	3	4	5	أوافق بشدة

أعتبر أن الأهداف التي يُطلب منّي تحقيقها مقبولة وعقلانية.

قم باختيار إجابة واحدة فقط

لا أوافق إطلاقًا	1	2	3	4	5	أوافق بشدة

لا يظهر رئيسي تفضيله لأيّ كان على الآخر.

قم باختيار إجابة واحدة فقط

لا أوافق إطلاقًا	1	2	3	4	5	أوافق بشدة

الموقف من مشاركة المعرفة

أعتبر أنّي أشارك المعرفة بشكل جيّد مع غيري من الأعضاء في المشروع.

قم باختيار إجابة واحدة فقط

لا أوافق إطلاقًا	1	2	3	4	5	أوافق بشدة

حوافز الاستجابة

بشكل عام، أحاول اتباع تعليمات رئيسي.

قم باختيار إجابة واحدة فقط

5 4 3 2 1

لا أوافق إطلاقًا — أوافق بشدة

بشكل عام، أقبل وأنفّذ قرار رئيسي، حتى لو كان مختلفًا عن قراري.

قم باختيار إجابة واحدة فقط

5 4 3 2 1

لا أوافق إطلاقًا — أوافق بشدة

بشكل عام، أحترم قرار زميلي وأضعه قيد التنفيذ.

قم باختيار إجابة واحدة فقط

5 4 3 2 1

لا أوافق إطلاقًا — أوافق بشدة

النية في مشاركة المعرفة

الرغبة بمشاركة المعرفة الضمنية

أنوي مشاركة تجربتي وخبراتي من العمل بشكل أكبر مع أعضاء المشروع.

قم باختيار إجابة واحدة فقط

5 4 3 2 1

لا أوافق إطلاقًا — أوافق بشدة

سأقوم دائمًا بتقديم معرفتي بمكامن و مالكي المعرفة عندما يطلبها أعضاء المشروع.

قم باختيار إجابة واحدة فقط

5 4 3 2 1

لا أوافق إطلاقًا — أوافق بشدة

سأحاول مشاركة خبراتي التعلمية والتدريبية بشكل أكثر فعالية مع أعضاء المشروع.

قم باختيار إجابة واحدة فقط

5 4 3 2 1

لا أوافق إطلاقًا — أوافق بشدة

أعتبر أنّ مشاركتي للمعرفة مع غيري من الأعضاء في المشروع مضرّة.

قم باختيار إجابة واحدة فقط

5 4 3 2 1

لا أوافق إطلاقًا — أوافق بشدة

أعتبر أن مشاركتي للمعرفة مع غيري من الأعضاء في المشروع تجربة ممتعة.

قم باختيار إجابة واحدة فقط

5 4 3 2 1

لا أوافق إطلاقًا — أوافق بشدة

إنّ مشاركتي للمعرفة مع غيري من أعضاء المشروع هو أمر ذو قيمة بالنسبة إليّ.

قم باختيار إجابة واحدة فقط

5 4 3 2 1

لا أوافق إطلاقًا — أوافق بشدة

أعتبر أنّه من الحكمة أن أشارك المعرفة مع غيري من الأعضاء في المشروع.

قم باختيار إجابة واحدة فقط

5 4 3 2 1

لا أوافق إطلاقًا — أوافق بشدة

المعيار الذاتي

المعتقدات السائدة حول مشاركة المعرفة

يعتقد رئيسي أنّه عليّ مشاركة المعرفة مع غيري من الأعضاء في المشروع.

قم باختيار إجابة واحدة فقط

5 4 3 2 1

لا أوافق إطلاقًا — أوافق بشدة

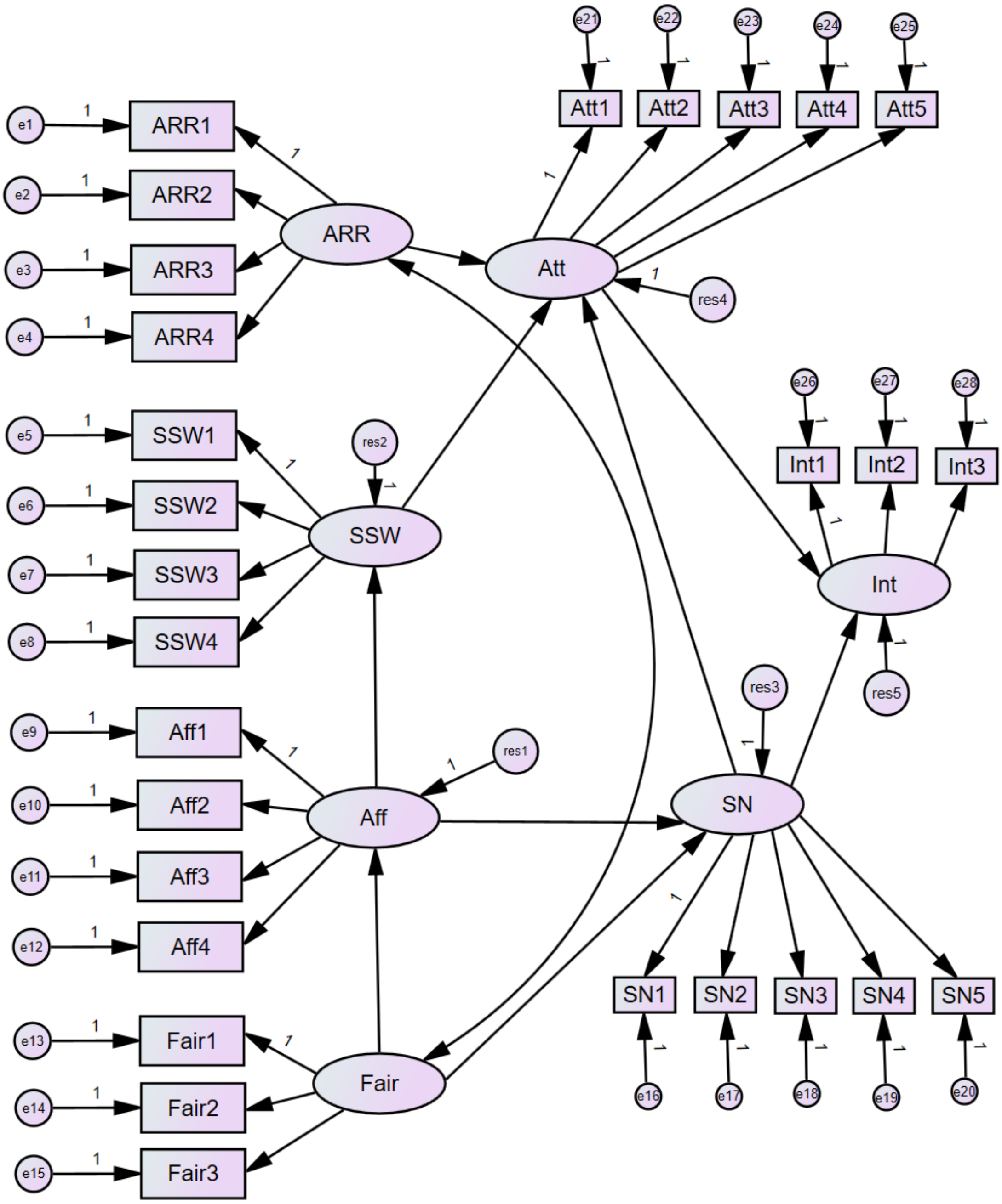
يعتقد زملائي أنّه عليّ مشاركة المعرفة مع غيري من الأعضاء في المشروع.

قم باختيار إجابة واحدة فقط

5 4 3 2 1

لا أوافق إطلاقًا — أوافق بشدة

Appendix D: Snapshot of first structural model in Amos



Appendix E: Overall model fit criteria

Goodness-of-Fit Measure	Levels of Acceptable Fit	Acceptability
Absolute fit measures		
Likelihood ratio chi-square statistic (x^2)	Not statistically significant or statistically significant and x^2 must be less than 2 times model's degrees of freedom	Model may fit the data
Goodness-of-fit index (GFI)	Higher values indicate better fit (0.85)	(Marginal)
Root mean square residual (RMR)	Small values are better (0.076)	(Marginal)
Root mean square error of approximation (RMSEA)	≤ 0.08 (0.09)	Acceptable (marginal)
Incremental fit measures		
Adjusted goodness-of-fit index (AGFI)	≥ 0.9 (0.8)	(Marginal)
Tucker-Lewis index (TLI)/ Non-normed fit index (NNFI)	≥ 0.9 (0.8)	(Marginal)
Normed fit index (NFI)	≥ 0.9 (0.8)	(Marginal)
Comparative fit index (CFI)	Higher values are better (≥ 0.9)	(Adequate)
Relative fit index (RFI)	Higher values are better	
Incremental fit index (IFI)	Higher values are better	
Parsimonious fit measures		
Normed chi-square: x2/df	Between 1 and 3	Good
Parsimonious goodness-of-fit index (PGFI)	Higher values are better, greater than 0.5 and closer to 1	Good
Parsimonious normed fit index (PNFI)	Higher values are better, greater than 0.5	Good
Akaike information criterion (AIC)	Smaller values are better (compared to the 2 models done by Amos)	Good

(Diamantopoulos et al. 2000; Fang et al. 2015; Hair et al. 1998; Tabachnick et al. 2007)

Appendix F: Results of model fit for runs 1, 2, and 5 of step 2

Results for goodness-of-fit measures for step 2

Goodness-of-Fit Measure	**Calculation of Measure**			**Acceptability**
	Run 1	*Run 2*	Run 5	
Absolute Fit Measures				
x^2	Significant 553<2*DF (2*340)	Significant 521<2*DF (2*314)	Significant 408.462<2*DF (2*242)	Model may fit the data
GFI	0.77	0.775	0.798	Not acceptable
RMR	0.064	0.061	0.061	Good fit
RMSEA	0.072	0.074	0.075	Good fit
Incremental Fit Measures				
AGFI	0.726	0.729	0.75	Not acceptable
TLI/ NNFI	0.745	0.747	0.775	Not acceptable
NFI	0.577	0.589	0.635	Not acceptable
CFI	0.77	0.774	0.803	Not acceptable
RFI	0.529	0.541	0.584	Not acceptable
IFI	0.779	0.783	0.811	Marginal
Parsimonious Fit Measures				
x^2/df	1.628	1.662	1.688	Good
PGFI	0.645	0.644	0.644	Acceptable
PNFI	0.519	0.527	0.557	Acceptable
AIC	685.4	649.898	524.462	Good

Results for measurement model fit measures for step 2

Question	Component	Cronbach's alpha			λ (Standardized loading weight)			ε (Error variance)			Composite reliability			Variance extracted		
		Run 1	*Run 2*	Run 5	Run 1	*Run 2*	Run 5	Run 1	*Run 2*	Run 5	Run 1	*Run 2*	Run 5	Run 1	*Run 2*	Run 5
ARR1	ARR	0.689	0.689	0.689	0.568	0.568	0.565	0.677	0.677	0.681	0.69	0.69	0.69	0.36	0.36	0.36
ARR2					0.480	0.481	0.484	0.770	0.769	0.766						
ARR3					0.673	0.674	0.677	0.547	0.546	0.542						
ARR4					0.662	0.661	0.655	0.562	0.563	0.571						
	SUM				2.383	2.384	2.381	2.556	2.555	2.559						
SSW1	SSW	0.727	0.727	0.727	0.498	0.498	0.497	0.752	0.752	0.753	0.76	0.76	0.76	0.44	0.44	0.44
SSW2					0.724	0.725	0.716	0.476	0.474	0.487						
SSW3					0.747	0.746	0.754	0.442	0.443	0.431						
SSW4					0.665	0.665	0.662	0.558	0.558	0.562						
	SUM				2.634	2.634	2.629	2.228	2.228	2.234						
Aff1	Aff	0.765	0.765	0.765	0.651	0.645	0.668	0.576	0.584	0.554	0.76	0.76	0.77	0.45	0.45	0.46

Aff2					0.654	0.649	0.680	0.572	0.579	0.538							
Aff3					0.686	0.690	0.698	0.529	0.524	0.513							
Aff4					0.686	0.690	0.653	0.529	0.524	0.574							
	SUM				2.677	2.674	2.699	2.207	2.211	2.178							
Fair1	Fair	0.531	0.531	0.531	0.566	0.560	0.550	0.680	0.686	0.698	0.52	0.51	0.53	0.26	0.26	0.28
Fair2					0.470	0.464	0.507	0.779	0.785	0.743							
Fair3					0.502	0.508	0.516	0.748	0.742	0.734							
	SUM				1.538	1.532	1.573	2.207	2.213	2.174							
Att1	Att	0.631	0.631	0.666	0.387	0.391	0.395	0.850	0.847	0.844	0.66	0.66	0.69	0.30	0.3	0.36
Att2					0.246	0.245	----------	0.939	0.940	-----------							
Att3					0.656	0.654	0.655	0.570	0.572	0.571							
Att4					0.710	0.709	0.699	0.496	0.497	0.511							
Att5					0.610	0.610	0.609	0.628	0.628	0.629							
	SUM				2.609	2.609	2.358	3.483	3.485	2.555							
SN1	SN	0.515	0.535	0.175	0.595	0.596	0.84	0.646	0.645	0.294	0.56	0.57	0.56	0.21	0.25	0.42

SN2					0.5	0.51	0.378	0.750	0.740	0.857						
SN3					0.390	0.392	----------	0.848	0.846	-----------						
SN4					0.228	----------	----------	0.948	-----------	-----------						
SN5					0.505	0.487	----------	0.745	0.763	-----------						
	SUM				2.218	1.985	1.218	3.937	2.994	1.152						
Int1	Int	0.773	0.773	0.773	0.806	0.804	0.804	0.350	0.354	0.354	0.77	0.77	0.77	0.53	0.53	0.53
Int2					0.745	0.746	0.748	0.445	0.443	0.440						
Int3					0.619	0.621	0.619	0.617	0.614	0.617						
	SUM				2.170	2.171	2.171	1.412	1.411	1.411						

Results for discriminant validity for step 2

Component	**ARR**	**SSW**	**Aff**	**Fair**	**Att**	**SN**	**Int**
ARR	**0.60**						
SSW	.517**	**0.67/<u>0.66</u>**					
Aff	.271**	.468**	**0.67**				
Fair	0.137	0.173	.412**	**0.51/<u>0.52</u>**			
Att	.341**/<u>.385**</u>	.345**/<u>.398**</u>	.339**/<u>.388**</u>	.225*/<u>.211**</u>	**0.55/<u>0.6</u>**		
SN	0.174/*.207**/<u>.132</u>	.356**/*.419***/<u>.338**</u>	.386**/*.437***/<u>.347**</u>	.382**/*.367***/<u>.393**</u>	.422**/*.498***/<u>.466**</u>	**0.46/<u>0.65</u>**	
Int	.266**	.200*	.407**	.207*	.448**	.406**/*.415***/<u>.415**</u>	**0.73**

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

Appendix G: Constructs' division upon EFA results

New constructs' labels and indicators for run 1

Factor ID	Variables	Factor Label
F1	My knowledge sharing would strengthen the ties between project members and myself	Contributions: contributions of knowledge sharing on team integration
	My knowledge sharing would get me well-acquainted with new project members	
	My knowledge sharing would expand the scope of my association with other project members	
	My knowledge sharing would draw smooth cooperation from outstanding project members in the future	
	My knowledge sharing would help other project members solve problems	
	My knowledge sharing with other project members is an enjoyable experience	
	My knowledge sharing with other project members is valuable to me	
F2	I can trust my boss's evaluation to be good	Perception: intra-team perception of authority and knowledge sharing
	Tasks which are given to me are reasonable	
	My boss doesn't show favoritism to any one	
	My knowledge sharing with other project members is good	
	My boss thinks that I should share my knowledge with other members in the project	
F3	My knowledge sharing would improve work processes in the project	Self-worth: sense of self-worth in regard to knowledge sharing
	My knowledge sharing would increase productivity in the project	
	My knowledge sharing would help the project achieve its performance objectives	
F4	Generally speaking, I accept and carry out my boss's decision even though it is different from mine	Undefined
	Generally speaking, I respect and put in practice my colleague's decision	
F5	My knowledge sharing with other project members is harmful	Undefined
	My knowledge sharing with other project members is a wise move	
F6	Members in my team keep close ties with each other	Affiliation: team affiliation
	Members in my team consider other members' standpoint highly	

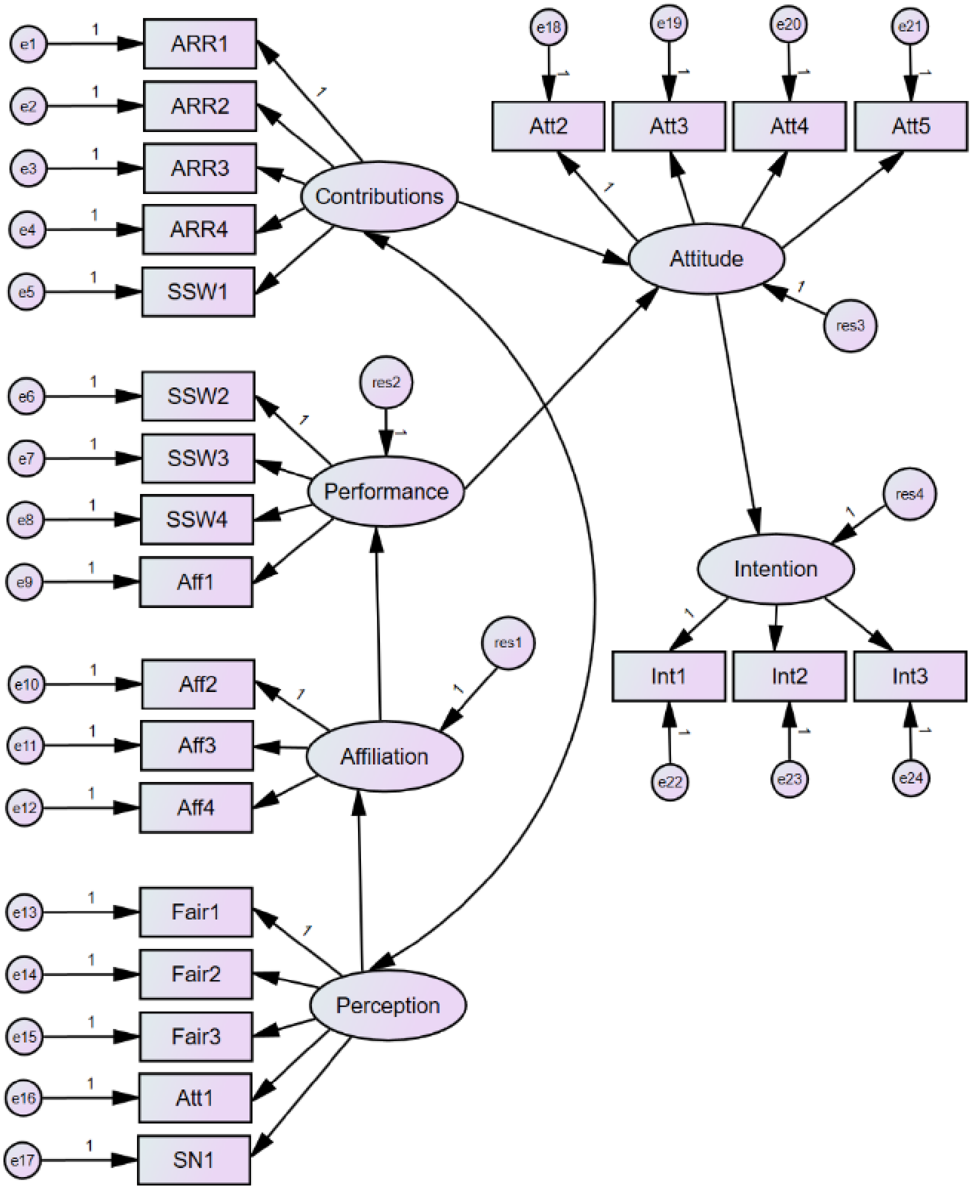
	Members in my team have a strong feeling of unity	
	Members in my team cooperate well with each other	
F7	My colleagues think I should share my knowledge with other members in the project	Undefined
	Generally speaking, I try to follow my boss's directions	

New constructs' labels and indicators for run 2

Factor ID	**Variables**	**Factor Label**
F1	My knowledge sharing would strengthen the ties between project members and myself	Contributions: contributions of knowledge sharing on team integration
	My knowledge sharing would get me well-acquainted with new project members	
	My knowledge sharing would expand the scope of my association with other project members	
	My knowledge sharing would draw smooth cooperation from outstanding project members in the future	
	My knowledge sharing would help other project members solve problems	
F2	I can trust my boss's evaluation to be good	Perception: intra-team perception of authority and knowledge sharing
	Tasks which are given to me are reasonable	
	My boss doesn't show favoritism to any one	
	My knowledge sharing with other project members is good	
	My boss thinks that I should share my knowledge with other members in the project	
F3	My knowledge sharing with other project members is harmful	Attitude: attitude towards knowledge sharing
	My knowledge sharing with other project members is an enjoyable experience	
	My knowledge sharing with other project members is valuable to me	
	My knowledge sharing with other project members is a wise move	
F4	Generally speaking, I accept and carry out my boss's decision even though it is different from mine	Undefined
	Generally speaking, I respect and put in practice my colleague's decision	
F5	My knowledge sharing would improve work processes in the project	

	My knowledge sharing would increase productivity in the project	Performance: project performance assessment and knowledge sharing
	My knowledge sharing would help the project achieve its performance objectives	
	Members in my team keep close ties with each other	
F6	Members in my team consider other members’ standpoint highly	Affiliation: team affiliation
	Members in my team have a strong feeling of unity	
	Members in my team cooperate well with each other	

Appendix H: Snapshot of first structural model post EFA results in Amos



Appendix I: Results of model fit for runs 1 and 10 of step 4

Results for goodness-of-fit measures for step 4

Goodness-of-Fit Measure	**Calculation of Measure**		**Acceptability**	
	Run 1	Run 10	Run 1	Run 10
Absolute Fit Measures				
x^2	Significant 4711<2*DF (2*246)	Significant 366.6<2*DF (2*237)	Model may fit the data	Model may fit the data
GFI	0.747	0.837	Not acceptable	Marginal
RMR	0.104	0.094	Not acceptable	Acceptable
RMSEA	0.082	0.063	Marginal	Good fit
Incremental Fit Measures				
AGFI	0.747	0.794	Not acceptable	Not acceptable
TLI/ NNFI	0.815	0.889	Marginal	Marginal
NFI	0.712	0.776	Not acceptable	Not acceptable
CFI	0.835	0.905	Marginal	Acceptable
RFI	0.677	0.739	Not acceptable	Not acceptable
IFI	0.838	0.908	Marginal	Acceptable
Parsimonious Fit Measures				
x^2/df	1.916	1.547	Acceptable	Acceptable
PGFI	0.65	0.661	Acceptable	Acceptable
PNFI	0.635	0.667	Good	Good
AIC	579	492.6	Good	Good

The results have improved such that there are at least two fit measures in each category considered as acceptable.

Results for measurement model fit measures for step 4

Item	**Construct**	**Cronbach's alpha**	**λ (Standardized loading weight)**		**ε (Error Variance)**		**Composite reliability**		**Variance extracted**	
		Run 1 and Run 10	Run 1	Run 10	Run 1	Run 10	Run 1	Run 10	Run 1	Run 10
ARR1	Contributions	0.834	0.700	0.716	0.510	0.487	0.84	0.82	0.51	0.49
ARR2			0.685	0.679	0.531	0.539				
ARR3			0.814	0.750	0.337	0.438				
ARR4			0.750	0.754	0.438	0.431				
SSW1			0.590	0.576	0.652	0.668				
	SUM		3.539	3.475	2.468	2.564				
Fair1	Perception	0.68	0.625	0.650	0.609	0.578	0.69	0.69	0.31	0.31
Fair2			0.561	0.523	0.685	0.726				
Fair3			0.524	0.506	0.725	0.744				
Att1			0.514	0.512	0.736	0.738				
SN1			0.553	0.591	0.694	0.651				
	SUM		2.777	2.782	3.450	3.437				
SSW2	Performance	0.798	0.713	0.725	0.492	0.474	0.84	0.83	0.57	0.55
SSW3			0.858	0.852	0.264	0.274				
SSW4			0.828	0.814	0.314	0.337				
Aff1			0.591	0.550	0.651	0.698				
	SUM		2.990	2.941	1.721	1.783				
Att2	Attitude	0.727	0.243	0.229	0.941	0.948	0.74	0.74	0.46	0.45
Att3			0.839	0.841	0.296	0.293				
Att4			0.866	0.874	0.250	0.236				
Att5			0.557	0.529	0.690	0.720				
	SUM		2.505	2.473	2.177	2.197				

Aff2	Affiliation	0.798	0.701	0.601	0.509	0.639	0.80	0.77	0.57	0.54
Aff3			0.783	0.769	0.387	0.409				
Aff4			0.772	0.813	0.404	0.339				
	SUM		2.256	2.183	1.300	1.386				
Int1	Intention	0.828	0.764	0.766	0.416	0.413244	0.83	0.83	0.62	0.62
Int2			0.813	0.807	0.339	0.348751				
Int3			0.784	0.789	0.385	0.377479				
	SUM		2.361	2.362	1.141	1.139				

Results for discriminant validity for step 4

Components	Contributions	Perception	Performance	Attitude	Affiliation	Intention
Contributions	**0.71/ 0.70**					
Perception	.181*	**0.56**				
Performance	.588**	.325**	**0.75/ 0.74**			
Attitude	.461**	.281**	.330**	**0.68/ 0.67**		
Affiliation	.452**	.416**	.629**	.368**	**0.75/ 0.73**	
Intention	.273**	.224**	.303**	.499**	.270**	**0.79**
****. Correlation is significant at the 0.01 level (2-tailed).**						
***. Correlation is significant at the 0.05 level (2-tailed).**						

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