Improving construction labor productivity based on self-determination theory: A case study in Vietnam

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A dissertation submitted to the
Engineering Course, Department of Engineering,
Graduate School of Engineering,
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in partial fulfillment of the requirements for the degree of
Doctor of Philosophy

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March 2023

Gloria Patri, et Filio, et Spiritui Sancto,

sicut erat in principio, et nunc, et semper,

et in saecula saeculorum. Amen.

Công Cha như núi Thái Sơn,

Nghĩa Mẹ như nước trong nguồn chảy ra.

Một lòng thờ Mẹ kính Cha,

Cho tròn chữ hiếu mới là đạo con.

-Ca dao Việt Nam-

Luận án Tiến sĩ này con xin dành tặng Cha Mẹ, người đã tần tảo sớm hôm, vất vả cả cuộc đời để cho con những điều tốt đẹp nhất!

I dedicate this dissertation to my loving parents

Nguyen Van Thanh & Tran Thi Quyet

Abstract

Improving construction labor productivity based on self-determination theory: A case study in Vietnam

Construction labor productivity (CLP) is an important aspect of the construction industry. The construction sector, in many developing countries such as Vietnam, has been identified with many problems, and one of the major problems is poor labor productivity. To solve this problem, many studies have identified and classified the factors that significantly influence this aspect. As a result, to improve CLP, the role of controlled motivation (CM) has been identified, while the role of autonomous motivation (AM) has been under-researched. On the construction sites, CM is basically represented by well-known "Carrots and Sticks" (i.e., reward and punishment). However, the concern is centered on whether CM is the best way to improve CLP or not. In this regard, the author considered these following points: Firstly, there exist both autonomous and controlled motivations in human nature. Secondly, AM is an important value that promotes interest and enjoyment at work. These encourage engagement at work, resulting in a higher performance. Thirdly, some Vietnamese construction managers claimed the significant role of AM in enhancing work performance. Finally, previous studies have only identified the role of CM on improving CLP, whereas, studying AM in the construction domain has been insufficiently researched. Therefore, identifying the role of AM promisingly provides a new direction for effective and sustainable labor management. In this regard, self-determination theory (SDT) is promising in terms of its ability to bridge this gap and explain how AM can be generated by integrating reasonable leadership styles and basic psychological needs satisfaction (BPNS). Therefore, this project was conducted

to identify the role of AM in improving CLP based on SDT perspective. This project included three studies as follows:

The first study identified the importance of AM in CLP improvement. To do so, the author developed a novel model for assessing the effects of engaging leadership, three basic psychological satisfaction (i.e., autonomy, competence, and relatedness), work motivation (i.e., autonomous motivation, controlled motivation and amotivation) and work engagement on CLP. The structural equation modelling (SEM) results showed several interesting and valuable features. The first feature identified the role of controlled motivation (CM) in CLP improvement. This finding reinforced and supported the conventional view with respect to improving CLP by emphasizing the role of CM. The second feature identified "new light of hope" on effective labor management with respect to how CLP can be enhanced, and how AM can be generated and maintained. Specifically, the important role of AM in improving CLP was identified. In addition, to improve AM and CLP, the satisfaction of competence and relatedness played vital roles. The third feature identified the "negative legacy" of the Vietnamese construction industry. Specifically, this feature implied that the older and experienced, but not necessarily skillful, workers perceived autonomy satisfaction as being achieved through selfish work, resulting in an obstacle to productivity improvement. Selfish work is a novel factor that negatively contributes to labor productivity in the construction industry. The fourth feature identified that work engagement did not significantly contribute to CLP. Theoretically, this study expands and reinforces SDT knowledge by comprehensively illuminating leadership and psychological and motivational aspects in the construction context. Practically, this study provides substantial recommendations for CLP improvement, such as enhancing autonomous motivation, promoting satisfaction with competence

and relatedness, and reducing selfish work.

In the first study, the author identified “new light of hope” (i.e., the importance of AM improving CLP) brings a new direction for effective and efficient labor management which improves CLP, whereas “negative legacy” decreases CLP. The question lingers on how can “new light of hope” increase? and how can “negative legacy” decrease? To address this question, the author studies work autonomy (by integrating three types of work motivation) because studying this aspect promisingly solves the above-mentioned question and brings several potential benefits for both theoretical and practical labor management with respect to improving CLP. Therefore, in the second study, the author studied work autonomy (WA) and identified its role in improving CLP by developing a new research model. The author quantitatively measured the WA level of workers by adopting Relative Autonomy Index (RAI) and Aggregated Motivation Index (AMI). AMI is aggregated by combining AM and CM, this index was developed and justified by this research as an auxiliary index. Specifically, the RAI explains differences in WA between genders, while the AMI more precisely accounts for dissimilarities in WA on the basis of work experience. In the second study, the author identified four valuable features with respect to labor management. The first feature is related to the gender issue which identified that, in Vietnam, many female workers may tend to engage in onsite tasks to maintain their roles as housewives. The second feature is related to the work experience issue which identified two latent and potentially extensive labor management-related problems, namely, unsuccessful career development and the underutilization of experienced workers. The third feature identified the important role of WA in improving CLP. The fourth feature identified that WA can be cultivated and maintained by promoting satisfaction with competence and relatedness. Based on the results and findings, the

author proposed a motivation matrix as a conceptual diagram that distinguishes inexperienced workers, female workers, experienced workers, and “ideal” workers in four quadrants with their own characteristics. Theoretically, this study expands the body of knowledge by (1) developing and justifying the AMI as an auxiliary to conventional indices, (2) proposing five conditions necessary for optimal scoring in WA measurement and (3) developing a motivation matrix that identifies and distinguishes the characteristics of different groups. In practical terms, the findings support the introduction of reasonable policies that advance the career development of workers, promote WA and improve CLP. These achievements, in turn, significantly advance effective and sustainable construction workforce management.

The first study examined how work motivation can be promoted by BPNS, in fact, however, many other factors in addition to BPNS can influence work motivation of construction workers. Hence, the third study managed 35 factors constraining their work motivation in construction projects. This study differs from past studies in CLP research by investigating the severity level and occurrence frequency of barriers to work motivation in construction projects, and provides a more realistic ranking of these factors by adopting a risk mapping approach. The results indicated that the following barriers as the most significant factors constraining work motivation in construction projects: (1) lack of professional training and advanced learning opportunities, (2) unskilled workforce, (3) lack of financial incentive schemes, (4) payment delay, (5) poor work conditions, and (6) work dissatisfaction.

Keywords: autonomous motivation, work autonomy, construction labor productivity, self-determination theory, Vietnam.

Acknowledgments

Thanks be to God!

Thanks, the Blessed Virgin Mary!

God is the source of Life, Knowledge, and Wisdom. God has given me knowledge and understanding, without him, I cannot do anything.

During my Ph.D. journey, I have received great support, guidance, and encouragement from many wonderful people, to whom, I am very grateful from the bottom of my heart; without them, my dissertation would not have been possible.

First and foremost, I would like to express my sincere gratitude to my advisor, Professor Tsunemi Watanabe, who is a very kind, generous person, and has enormous expert knowledge. He provided insightful comments, meaningful understanding, and great support throughout the implementation of this laborious work. His patient, guidance and great support helped me grow and develop as a researcher. With his kindness and sympathetic heart, he helped me to overcome my suffering and difficult problems. I feel that he always tries his best to work for making the happiness of people which inspires me to become more responsible for the social community with passion and a sincere attitude. I was lucky enough to have him as my advisor.

Secondly, I would like to express my special appreciation and thanks to Professor Satoshi Tsuchiya who became my advisor since December 2022. He helped and supported me very much to complete my works. In addition, I am very thankful for passionate of my dissertation scientific committee members: Professor Steve Rowlinson, Professor Yoshinori Nakagawa, Associate Professor Katsumasa Ohori, and Associate Professor Hitoshi Ninomiya. Their expert experiences gave me constructive feedback and valuable comments which greatly enhanced the quality of my project.

Thirdly, I would like to sincerely thank Associate Professor Nguyen Luong Hai who gave me great support during the process of obtaining my Ph.D. scholarship. His experience gave me detailed comments and suggestions which supported me completed this challenging work. In addition, my gratitude goes to Dr. Ho Thi Thanh Hien, Dr. Nguyen Lien Huong, Dr. Dinh Tuan Hai, Dr. Nguyen Quoc Toan, and my colleagues at Hanoi University of Civil Engineering, who supported me during my scholarship process and research. Furthermore, I would thank four research assistants to support me in data collection in Vietnam.

Fourthly, I would like to sincerely thank to the Kochi University of Technology for supporting financial and environmental to do this work. Especially, I am grateful for great support of members of International Relations Center (Mr. Kensaku Kubo, Mr. Makoto Takeda, Ms. Mami Miyabayashi, Mr. Motoi Yoshida, Ms. Saki Hamamura and other staff members). They gave me great support during my study and living in Kochi. Additionally, I would like to extend my joyful appreciation to my lab members (Dr. Tam, Dr. Anne, Dr. Lingling, Mr. Idrees, Mr. Beer and Mr. Valentine) of their great friendship. They shared their experience of studying and living to me. We have great and memorable times together.

Con xin gửi lời cảm ơn chân thành đến Cha, Mẹ, Ông, Bà và toàn thể Anh, Chị, Em trong gia đình đã luôn đồng hành, động viên và giúp đỡ con trong suốt quá trình học tập và làm việc. Con không thể hoàn thành Luận án này nếu không có sự giúp đỡ của mọi người. Với tất cả tâm tình, con luôn cầu chúc mọi người bình an và hạnh phúc. Em cũng xin cảm ơn các anh chị Việt Nam tại Trường Đại học Công nghệ Kochi (anh Giang, chị Ngọc, chị Huyền, chị Hồng) đã giúp đỡ em rất nhiều trong suốt quá trình em học tập và sinh sống tại đây. Một lời cảm ơn chân thành xin được gửi đến toàn thể anh chị em Công giáo người Việt Nam tại Kochi và vùng Shikoku.

Finally, I would express my sincere gratitude to all people who appear in my life. Good people give me memories, others give me valuable lessons. From the bottom of my heart, I wish and pray all the best to you all.

May God bless all of you!

Nguyen Van Tam

Kochi, March 1st, 2023

Table of contents

List of Tables

List of Figures

List of Abbreviations

AS	Autonomy satisfaction
CS	Competence satisfaction
RS	Relatedness satisfaction
WA	Work autonomy
WE	Work engagement
CLP	Construction labour productivity
AM	Autonomous motivation
CM	Controlled motivation
Amot	Amotivation
Exter	External regulation
Intro	Introjected regulation
Iden	Identified regulation
Inte	Integrated regulation
Intri	Intrinsic regulation
RAI	Relative autonomy index
AMI	Aggregated motivation index
BPNS	Basic psychological needs satisfaction
SDT	Self-determination theory
EL	Engaging leadership
FDI	Foreign direct investment
GDP	Gross domestic product
SEM	Structural equation modelling
EFA	Exploratory factor analysis
CFA	Confirmatory factor analysis
KMO	Kaiser–Meyer–Olkin
BREQ	Behavioural regulation in exercise questionnaire
CFI	Comparative fit index
TLI	Tucker–Lewis's index
GFI	Goodness-of-fit index
AIC	Akaike information criterion
RMSEA	Root mean square error of approximation
AVE	Average Variance Extracted
CR	Composite Reliability
SI	Severity index
FI	Frequency index

Chapter 1. Introduction

1.1. Background of this study

The construction industry has a significant impact on the development of any economy all over the world. The activities of the industry such as provision of buildings and infrastructures contribute to the country's socio-economic development goals such as industrialization, freight transportation, sustainable development, and urbanization [1]. The construction industry acts as a backbone of the economic growth of any country; hence, it has a considerable influence on the socio-economic aspects [2, 3]. The effective and efficient construction sector management results in improved human life quality, including boosted tourism, money circulation sustainable environment, and job creation throughout the country [4]. The construction industry significantly contributes to the Gross Domestic Product (GDP), accounting for 5–7% of the total national GDP [5], thus the need for development in this sector is important.

As an important pillar of the Vietnamese economy, the construction sector accounted for an increasing contribution to the GDP while being one of the largest employers in Vietnam. In addition, it has been among the industries that attracted the most foreign direct investment (FDI) in the past years [6]. In 2021, the Vietnamese construction sector accounted for 5.95 percent of the country's total GDP (Fig. 1.1), equivalent to just under 500 trillion Vietnamese dongs. In that year, Vietnam's total GDP amounted to 8.4 thousand trillion Vietnamese dongs [7].

Although labor productivity of Vietnamese people has increased recently, it is still lower than in other countries in the Asia Southeast areas. Specifically, labor productivity of Vietnamese people is approximately equivalent to 7% that of Singapore, 17.6% that of Malaysia, 36.5% that of Thailand, 42.3% that of Indonesia,

56.7% that of Philippines, and 87.4% that of Laos [8]. In addition, labor productivity in the construction sector ranks sixteenth among the twenty industrial sectors in Vietnam [9]. This means the Vietnamese construction industry is facing one of big problems that is poor labor productivity. Furthermore, [10] explained that the lack of work motivation in the Vietnamese construction workforce is also a considerable problem that is one of the causes of low labor productivity.

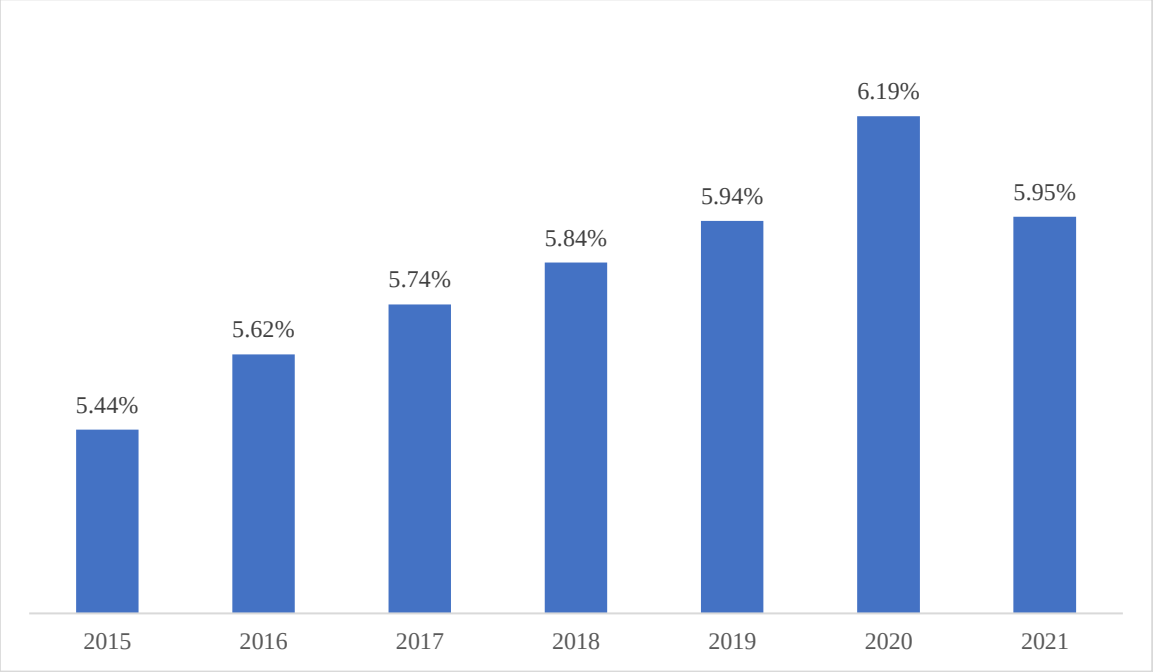

Figure 1.1. GDP contribution of construction sector in Vietnam 2015-2021

Source: https://www.statista.com/statistics/1047711/vietnam-gdp-contribution-of-construction-sector/

The construction sector, in many developing countries like Vietnam particularly, is facing numerous problems such as poor productivity, rising cost of materials, poor project performance, skilled labor shortages, and sustainability and efficiency issues which have hindered the progress and the development of this vital sector [11]. To solve existing problems, one of the most crucial solutions is improving the efficiency and effectiveness workforce management in the construction sector. In this manner, many efforts have been undertaken to guide practitioners and researchers to focus on

human- and management-related construction problems when devising strategic action plans to improve the construction industry of developing countries [12].

The construction sector employs a sizable portion of the labor force [13, 14]. It is therefore regarded as more labor intensive than other industries [15], with construction activities depending mainly on human resources and considerable workforce costs incurred as a result [16]. On sites, the primary workforce units are construction workers, whose productivity and quality of work can remarkably influence aspects of project performance (e.g., quality, cost, and time) [17-19]. Hence, an enhancement in worker productivity can markedly advance project effectiveness [18] and generate substantial cost savings for construction contractors [20]. Construction labor costs account for 30% to 50% of the total cost of a construction project in many countries; thus, construction labor productivity (CLP) determines the profitability of almost all such endeavors [9,11,12].

As emphasized, construction industries worldwide, including those in many developing countries like Vietnam, have been confronted with low level of labor productivity [21, 22]. This problem is dangerous because it leads to inflationary pressure and social conflicts in the country [23-25]. By identifying the factors that contribute to low CLP, contractors can address issues early on, reducing time and cost overruns [26-28]. Although much effort has been exerted to improve workers' skills and knowledge through training systems or programs, labor costs are constantly rising, and construction projects suffer noticeable delays owing to low CLP [12, 29]. These problems arise in large part because the workforce is the most difficult factor to define, manage, and quantify in construction projects [30]. This challenge highlights the criticality of identifying the determinants of CLP for the effective management of the labor force [31].

Regarding the poor CLP problem, construction practitioners and managers in

Vietnam claimed that autonomous motivation (AM) and work autonomy (WA) play an important role in enhancing work performance [32, 33]. Theoretically, there is a difference between AM and WA concepts. While AM refers to engaging in a behavior because it is perceived to be consistent with intrinsic goals or outcomes and emanates from the self [34], WA refers to how much freedom employees must do their jobs. Specifically, it relates to the pace at which work is completed, its order of completion, and a person's freedom to work without micromanagement [35]. In the construction sector, in addition to identifying the role of AM, quantitatively measuring WA and identifying its role in construction workforce management promisingly provide useful directions for both academics and practitioners with respect to effective and sustainable labor management. Particularly, some Vietnamese construction managers suggested that workers may tend to enthusiastically work when they feel a sense of voluntary action without micromanagement from their managers, which may promote work motivation to achieve the highest work performance. In addition, managers perceive that empowering plays a key role in enhancing work motivation and performance; hence, they are willing to offer more authority to their workers as long as they ensure desirable work outcomes [32, 33]. In other words, managers perceive the important roles of AM and WA in improving CLP. However, no study has provided empirical evidence to demonstrate these circumstances. An essential task, therefore, is to examine the roles of the AM and WA in CLP enhancement through empirical evidence. It is also vital to determine how AM and WA can be generated and maintained. The above-mentioned requirements can be satisfied using self-determination theory (SDT), which offers theoretical support for the existence of basic psychological needs satisfaction, which is important in individual motivation, growth, and performance [36, 37].

1.2. Research questions

The picture of the status quo of the Vietnamese construction industry and the abovementioned analyses, raise several research questions for this study as follows:

1. What is the role of AM in CLP improvement?
2. Can three basic psychological needs satisfaction generate and maintain (even promote) AM?
3. What is the role of WA in CLP improvement?
4. Can three basic psychological needs satisfaction generate and maintain (even promote) WA?
5. Which other factors in addition to basic psychological needs satisfaction that influence work motivation in construction projects?
6. Which recommendations should be formulated for improving CLP toward effective and sustainable construction workforce management?

1.3. Research objectives

This study aims to improve CLP by identifying the significant roles of AM and WA in this aspect and determining how AM and WA can be generated and maintained through satisfaction with three basic psychological needs.

To achieve this, specific objectives are as follows:

1. Identifying the significance of AM in CLP improvement.
2. Determining how AM can be generated and maintained through satisfaction with three basic psychological needs.
3. Identifying the significance of WA in CLP improvement.
4. Determining how WA can be generated and maintained through satisfaction with three basic psychological needs.

5. Identifying other factors in addition to basic psychological needs satisfaction that influence work motivation in construction projects.
6. Formulating recommendations for improving CLP toward effective and sustainable construction workforce management.

1.4. Research methodology

The present study adopted two approach perspectives, both qualitative and quantitative methods.

In terms of the qualitative approach, the author developed theoretical frameworks, research hypotheses, research models through referencing and considering previous studies, observations, and primarily survey. This study started by a comprehensive literature review focusing on SDT theory and CLP issues. The results supported a solid theoretical foundation for proposing novel models to examine the proposed research hypotheses and explore valuable features of the Vietnamese construction industry.

For the quantitative approach, the necessary data was collected through investigation carried out in the Vietnamese construction sites. Then, the collected data was analyzed by using appropriate statistical analysis techniques to achieve the goal of this study. Specifically, in the first study, the SEM was also conducted to explore the important role of AM in improving CLP with supporting and reinforcing of several other suitable statistical analysis techniques such as descriptive statistics; reliability of measured scale testing; exploratory factors analysis; confirmatory factors analysis. For the second study, the WA level of workers were quantitatively measured by adopting the Relative Autonomy Index (RAI) and an Aggregated Motivation Index (AMI); the structural equation modelling (SEM) was conducted to examine the effects of WA on CLP. Finally, the risk mapping method was adopted in

the third study to assess the factors constraining work motivation in construction projects.

1.5. Research scope

The scope of this study is focusing on CLP improvement in Vietnam based on the SDT perspective. Specifically, in this research, the author focused on CLP associated with simple tasks that do not require outstanding skills. Most onsite workers begin their practice by implementing straightforward responsibilities, such as rebar and masonry tasks, which account for the majority of construction quantity and cost for multistory residential projects in Vietnam. In addition, this study developed novel models and theoretical conceptual frameworks based on the popularly existing of SDT theory, these have empirically focused on the AM and WA in terms of the practical context of the construction industry in Vietnam.

1.6. Research structure

The dissertation includes seven chapters which represent whole content of this study as follows:

Chapter 1 introduces the status quo of the Vietnamese construction industry. On the basis of that, research questions and research objectives are identified. The research methodology and the scope of this study are also briefly explained.

Chapter 2 provides a solid theoretical foundation for developing novel models and research hypotheses. Specifically, the author presents the core content of related to SDT theory and CLP aspects such as engaging leadership, basic psychological needs satisfaction, work motivation based on SDT, work engagement and CLP measurement.

Chapter 3 shows the research methodology which includes questionnaire

development and procedure, the participants, the variable measured, and the statistical analysis techniques which were adopted to analyze the collected data.

Chapter 4 identifies the important role of AM in CLP improvement. To do so, the author develops a novel model for assessing the effects of engaging leadership, three basic psychological satisfaction factors, and work motivation on CLP. In addition, the author also determines how AM can be generated and maintained through BPNS; and determines how BPNS can be promoted through engaging leadership.

Chapter 5 measures WA level of workers and identifies the significant role of WA in improving CLP. To do so, the author attempts to develop and justify a new index as an auxiliary to conventional indices in WA measurement. In addition, a research model is developed to identify the role of WA in CLP improvement and determine how AM can be generated and maintained through BPNS.

Chapter 6 identifies and assesses other factors in addition to basic psychological needs satisfaction that influences work motivation in construction projects. The risk mapping is adopted to assess these factors in order to identify significant factors to enhance workers' motivation.

Chapter 7 summarizes the core findings of this study. The author emphasizes the contribution of this study to the body of knowledge and construction industry practice. In addition, the limitations of this study also are identified to highlight directions for further research.

The research structure of this study is visualized in Figure 1.2. Accordingly, Chapter 4 is based on [38], and Chapter 5 is based on [39].

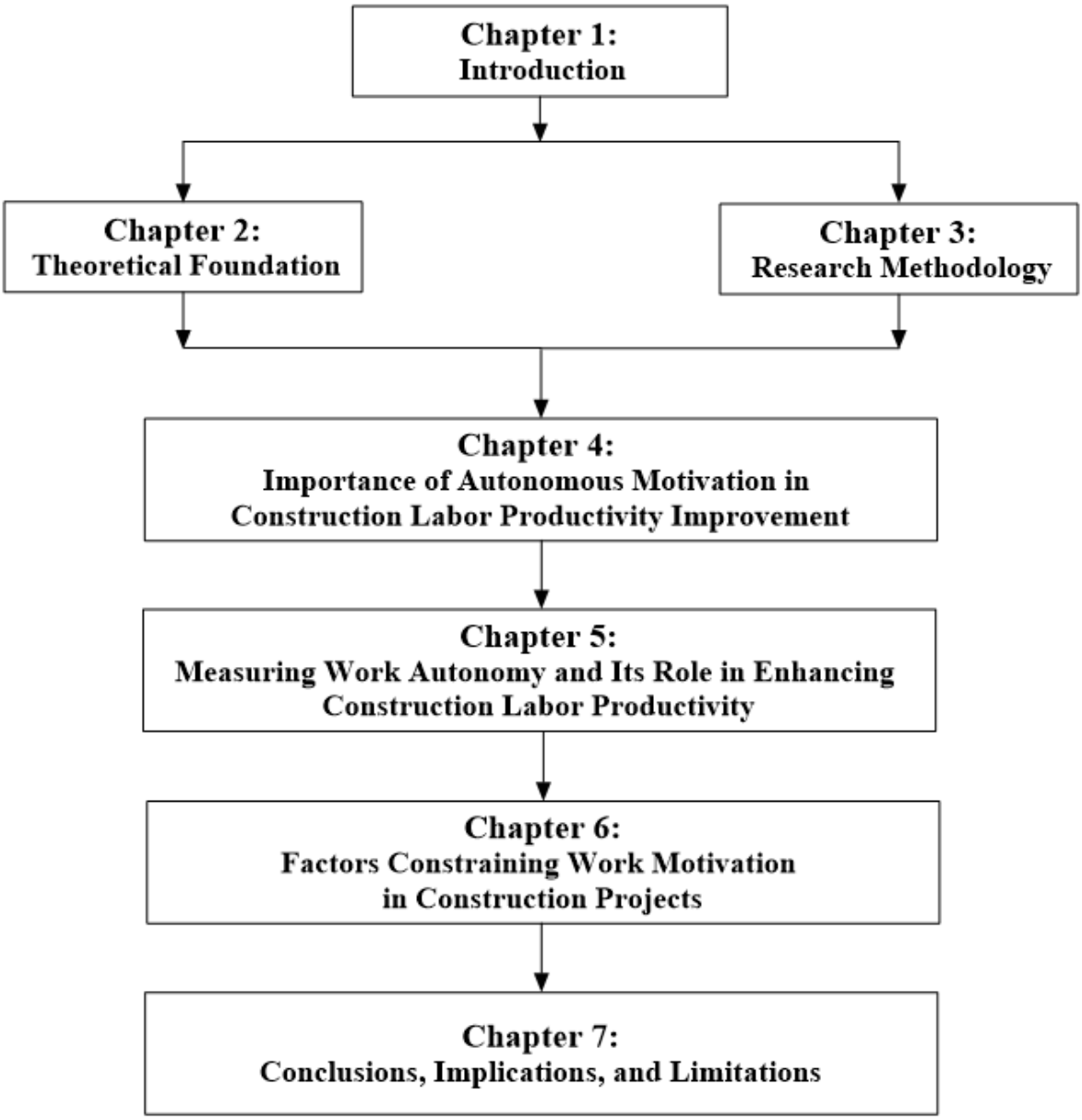

Figure 1.2. The research structure of this study

Chapter 2. Theoretical Foundation

2.1. Engaging Leadership

Engaging leadership (EL) is a new concept that focuses on SDT's theoretical considerations, especially Basis Psychological Needs (BPN) theory [40, 41]. From EL emerges a constructive leadership model with a strong theoretical basis and high predictive validity in terms of promoting work engagement [41]. Its hallmarks are integrity, openness and accountability; truly valuing others and their contributions; and the ability to be decisive and solve difficult challenges. Correspondingly, EL proposes a conceptualisation of leadership that seeks to help leaders create a work environment that satisfies the BPN of employees [42]. On the basis of SDT and the fulfilment of autonomy, competence and relatedness needs, EL emphasises three issues that leaders should pay attention to, namely, empowerment, strengthening and connection [41]. Empowerment advances the satisfaction of autonomy-related needs and is the component of leadership that enables workers to have a say in how they complete their tasks while also encouraging high standards of accountability [42]. Strengthening refers to supporting workers in their self-development and growth, as well as maximising the use of their skills in the workplace. It is associated with the fundamental need for integrity in this style of leadership, given that promoting strengths is favoured over fixing weaknesses [42]. EL often encourages workers to advance professionally and improve their abilities, by which employees understand the value of being successful at a responsibility on both personal and professional levels [43]. Connection emphasises the value of positive, interpersonal and in-depth relationships, and it involves encouraging cooperation, team spirit and collaboration among team members and across functions [42].

2.2. Basic Psychological Needs

Within SDT falls three basic psychological needs, namely, autonomy, competence and relatedness [36, 37]. Autonomy represents the inherent desire of individuals to feel volitional and experience a sense of choice and psychological freedom when carrying out an activity [44, 45]. SDT's notion of autonomy also encompasses the absence of pressure and conflict [46, 47]. Competence is defined as the innate yearning of individuals to feel effective in interacting with the environment [44, 48]. It prominently manifests itself in the propensity to explore and manipulate the environment and engage in challenging tasks to test and extend one's skills. Competence clears the way for individuals to adapt to complex and changing environments; competence-associated frustration is likely to result in helplessness and a lack of motivation [44]. Relatedness pertains to the intrinsic propensity of individuals to feel connected to others, that is, to be a member of a group, to love and care and to be loved and cared for [49]. Relatedness is satisfied when people experience a sense of communion and develop close and intimate relationships with others [44].

2.3. Work Motivation based on Self-Determination Theory

Self-Determination Theory (SDT) [36] assumes motivation to be the primary driver of people's actions or behavioural performance, implying that individuals enjoy conquering their social environments and are naturally self-motivated to do so [44, 50]. The theory proposes that all motivated behaviours can be located on an underlying autonomy continuum [36, 43], lying somewhere between feeling a complete lack of self-determination (external motivation) and experiencing thorough self-determination (internal motivation) [44]. Along this continuum, low to high levels of self-determination are determined on the basis of six constructs: amotivation, external regulation, introjected regulation, identified regulation, integrated regulation

and intrinsic regulation, as shown in Fig. 1. Amotivation refers to situations wherein individuals perceive no contingencies between outcomes and their actions, driving them to grapple with feelings of incompetence and uncontrollability [51]. External regulation represents behaviours that are managed through external means, such as reward or punishment. Introjected regulation pertains to behaviours that are beginning to be internalised, but are not fully self-determined. These behaviours can be performed, for example, to gain social recognition or avoid internal pressures and feelings of guilt [36]. Identified regulation refers to relatively self-determined behaviours that occur when individuals place value on and judge an activity as important to the self [43]. Integrated regulation is reflected in the attainment of inherently valued and important goals or outcomes, but such an action is fully endorsed by individuals [52]. Intrinsic regulation means highly autonomous behaviours that stimulate feelings of fun, pleasure and satisfaction, which stem from participation in an activity [36, 53]. If these constructs are to be classified in terms of motivation, then external regulation and introjected regulation are types of controlled motivation (which reflects low autonomy), whereas identified regulation, integrated regulation and intrinsic regulation belong to autonomous motivation (which points to high autonomy).

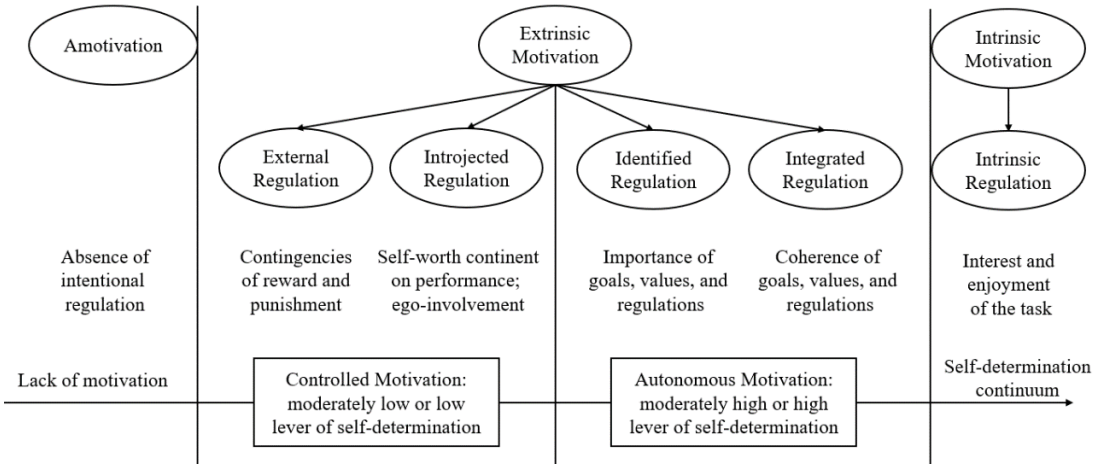

Figure 2.1. Work motivation based on SDT [36]

2.4. Work Engagement

Work engagement (WE) refers to 'the simultaneous employment and expression of a person's 'preferred self' in task behaviours that promote connections to work and to others, personal presence (physical, cognitive, and emotional), and active, full performances' ([54], p. 700). WE was first proposed in [54] as a motivational concept that provides employees with positive energy that they can devote to their jobs. The positive energy generated by the right type of motivation can give rise to improved organisational performance, with engaged employees contributing to their organisations by going above and beyond the efforts of their co-workers [55]. Numerous studies have emphasised the significance of work motivation in fostering employee engagement [56-59]. For instance, extrinsic and intrinsic types of motivation were investigated as antecedents of WE, and motivation crowding theory was empirically tested with hospitality employees as participants [56]. Previous research found a significant relationship between intrinsic motivation and WE [60, 61], with some studies discovering this association specifically in the context of employee WE. WE is also influenced by extrinsic motivation, but compared with intrinsic motivation, the former may have a shorter-term and more stable effect on the aforementioned engagement [59]. Note, however, that this relationship has been examined mostly on the basis of a two-pronged theory of motivation: intrinsic–extrinsic work motivation [62]. Meanwhile, [63] explained how intrinsic motivation stimulates academic engagement among learners. This effect is attributed to the increased likelihood that students will take on responsibility or participate in an activity if they deem it valuable, interesting and enjoyable [64].

2.5. Measurement of Worker Productivity

Different researchers have provided various definitions of productivity, which is ‘commonly defined as a ratio of a volume measure of output to a volume measure of input use’ [25]. In [65], the researchers defined productivity as the ratio of the outputs produced to the inputs used to produce the outputs. In [66, 67], it was described in a general sense as the maximisation of output and the optimisation of input.

In the construction context, labour productivity has been defined as the ratio between the units of work accomplished (i.e. output quantity) and the hours of work rendered (i.e. labour input) [68, 69]. Productivity can be measured at different levels, but there are three main measures used: industry, project and activity or process levels [25].

$$\text{Construction labour productivity} = \frac{\text{Installed quantity(kg,m3)}}{\text{Actual work hours (hr)}} \quad (1)$$

The analysis in this research involved two types of construction workers: rebar workers and masonry workers. The author first calculated their productivity levels in some core tasks on construction sites, with Circular No.10/2019/TT-BXD of the Vietnamese Construction Ministry for the Promulgation of Construction Norms (dated Dec. 26, 2019) as guidance [70]. The figures derived were then discussed in depth with professionals (e.g., managers, site engineers, supervisors, workers) to finalise reasonable productivity scales. Finally, productivity scales for several tasks were generated. With their practical experiences as reference, the workers were instructed to assess their productivity in specific tasks following the proposed scales.

Chapter 3. Research Methodology

3.1. Questionnaire Development and Procedure

To collect data, the author developed a questionnaire survey consisting of three main parts. Part I revolved around the general demographic information of the participants, such as gender, age, educational level, experience, marital status, weight, height and income. Part II comprised statements designed to measure the all variables treated in this work using a five-point Likert scale (1 = strongly disagree, 2 = disagree, 3 = neutral, 4 = agree, 5 = strongly agree). Part III includes a list of the 35 factors constraining work motivation in construction projects, the respondent was requested to evaluate the "severity" (how much its severity level decrease workers' motivation?) and the "probability of occurrence" (How often it is considered on construction site?) of the factors constraining following a 5-point Likert scale (i.e., for severity level measurement: 1-No severity; 2- Moderate severity; 3 – Strong severity; 4 – Very strong severity; 5 – Extreme severity; and for probability of occurrence: 1-Unlikely to happen, 2-May happen, 3-Likely to happen, 4-Very likely to happen, 5-Certain to happen).

Before the questionnaire was distributed, the author conducted a pilot study, through which a draft questionnaire was sent by email to academic experts and face-to-face interviews were carried out on construction sites. The pilot involved 21 participants (i.e., 3 academic experts, 1 project manager, 4 supervisors, 2 foremen, and 11 workers), who were asked to evaluate and provide constructive feedback on the suitability of the language, the content validity of the questionnaire, its structure and sequencing of questions, and its completeness. After receiving their feedback and comments, the author revised the questionnaire (e.g., enhancing readability, understandable, and refining CLP measurement scales). For the face-to-face

interviews, the author carefully trained four research assistants for them to comprehensively understand the research objectives, the content of the questionnaire and necessary survey techniques.

After the questionnaire was finalised, a survey was administered to 215 construction workers in Vietnam from April to July 2021. On the sites where the respondents worked, their companies were constructing multi-storey residential buildings, for which almost similar structural design features and construction methods were used. As stated earlier, the sample was composed primarily of rebar workers and masonry workers. Their participation was entirely voluntary, and they were informed of their right to withdraw at any time. They were assured of anonymity and that their privacy would be respected. The workers were briefed on the scope of the research before the questionnaires were administered, after which informed consent was obtained from them. The interview and questionnaire completion lasted approximately 40 minutes for each participant.

The participants were recruited via snowball sampling, which is a non-probability technique [71]. Specifically, interviews were initiated with a small number of workers overseen by a single contractor. Then, the sample was expanded, with the initially chosen respondents asked for referrals from other contractors.

3.2. Participants

The 215 construction workers participating in this study worked on five construction sites in Vietnam. Among whom 122 were rebar workers (56.7%) and 93 were masonry workers (43.3%). The demographic information of the workers is shown in Table 3.1.

Table 3.1. Demographic characteristics of the respondents

	Category	Frequency	Percentage
Gender	Male	187	87.0%
	Female	28	13.0%
Educational level	Primary school (1st–5th grades) and below	65	30.3%
	Secondary school (6th–9th grades)	94	43.7%
	High school (10th–12th grades) and above	56	26.0%
Age	<=35 years old (young workers [1])	162	75.4%
	>35 years old (older workers)	53	24.6%
Work experience	<5 years	94	43.7%
	5–10 years	84	39.1%
	>10 years	37	17.2%
Marital status	Single	50	23.3%
	Married	165	76.7%
Income [2]	Low income	95	44.2%
	High income	120	55.8%
Training	Untrained	182	84.7%
	Trained [3]	33	15.3%

[1] According to Youth Law No. 57/2020/QH14 (dated June 16, 2020), which was introduced by the Vietnamese National Assembly, young people are individuals aged 35 years and below [72].

[2] The yearly average income was calculated on the basis of Circular No. 15/2019/TT-BXD (dated 26 December 2019) of the Vietnamese Construction Ministry, which provides instruction on the calculation of unit labour costs in the construction sector [73].

Accordingly, the yearly average income is 3534 USD (1 USD = 22,952.5 VND).

Workers in the low-income group have a yearly income less than 3534 USD (mean = 3356 USD), and workers in the high-income group have a yearly income equal to or more than 3534 USD (mean = 4172 USD).

[3] Workers who took part in a professional training are defined as trained workers, otherwise, as untrained workers.

3.3. Variable Measured

3.3.1. Engaging Leadership

The EL scale developed by [41] encompassed 12 items intended to measure the three core aspects of the concept, namely, strengthening, connection and empowerment. Example statements are presented below:

- 'My supervisors encourage me to develop knowledge and skills as much as possible on my tasks.' (strengthening)
- 'My supervisors encourage collaboration among team members on sites.' (connection)
- 'My supervisors listen to how I would like to do things in improving my work efficiency.' (empowerment)

The participants were instructed to respond to the statements using a five-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree). After the model assessment step, eight items were chosen for the final model: two items on strengthening, two on connection and four on empowerment (all empowerment-related items were chosen).

3.3.2. Satisfaction of Basic Psychological Needs

The researchers in [74, 75] adopted 17 items from the BPN satisfaction scale, which has three psychometrically sound structural components that distinctly measure Autonomy Satisfaction (AS) (five items; e.g. 'I feel that my decisions reflect what I really want.'); Competence Satisfaction (CS) (six items; e.g. 'I feel I can competently achieve my goals and company goals.'); and Relatedness Satisfaction (RS) (six items; e.g. 'I feel close and connected with other people onsite.'). These items were rated using a five-point Likert scale ranging from 1 (*strongly disagree*) to 5 (*strongly agree*). After the model assessment step, 13 of the BPN items were incorporated into our final model: five AS items, four CS items and four RS items.

3.3.3. Six Motivational Subscales

Motivational subscale items were obtained from [76-78] and measured on a five-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree). The question stem was 'Why do you or would you put effort into your current job on a construction site?' Amotivation was measured with four items (e.g., 'I don't because I really feel that I am wasting my time at work'), external regulation with nine items (e.g., 'Because I will be rewarded financially only if I put enough try into my job'), introjected regulation with six items (e.g., 'Because I have to prove to myself that I can'), identified regulation with six items (e.g., 'Because I receive appropriate feedback from my supervisors, teammates'), integrated regulation with five items (e.g., 'Because putting try into this job aligns with my personal values') and intrinsic regulation with eight items (e.g., 'Because I enjoy finding valuable solutions from others').

3.3.4. Work Engagement

The WE variable developed by [79] was measured using 18 items revolving around three WE dimensions, namely, physical, cognitive and emotional engagement. These items were applied to the context of construction sites. After the model assessment step, only four items were included in the final model (e.g. 'I work extra hours to smoothen work procedures and complete my work before the deadline.'; 'I always follow rules/regulations in the workplace to ensure my work efficiency.').

3.3.5. Worker productivity

Five simple tasks (or tasks that do not require excellent skills) in which the workers exhibited productivity onsite were determined and rated on a five-point scale ranging from 1 (the lowest productivity) to 5 (the highest productivity). The items were ascertained on the basis of Circular No.10/2019/TT-BXD [70] and in-depth

discussions with construction professionals. After the model assessment step, only three items were included in the final model. Example statements are listed below:

- For rebar workers: ‘How many average kilograms of rebar can you process (i.e. cutting, bending and shaping according to drawn specifications) per shift (eight hours)?’ The evaluation scales were (1) <150 kg, (2) 150–170 kg, (3) 171–190 kg, (4) 191–210 kg and (5) >210 kg
- For masonry workers: ‘How many average cubic meters of straight walls can you build using baked clay bricks per shift (eight hours)?’ The evaluation scales were (1) <0.6 m^3, (2) 0.6–0.7 m^3, (3) 0.71–0.8 m^3, (4) 0.81–0.9 m^3 and (5) >0.9 m^3.

3.3.5. Control Variables

The influence of the construction workers’ demographic characteristics [e.g. gender, age, educational level, work experience, marital status, income and body mass index (BMI)] on their productivity was analysed.

3.5. Measurement Methods

3.5.1. Principal Component Analysis

Principal component analysis was conducted to examine the link between the latent variables and their indicators, consistent with the exploratory nature of the research goal [80]. This method of analysis is useful for demonstrating convergent and discriminant validity, as well as for reducing the number of variables to consider in subsequent analyses. Key reliability tests, namely, the Kaiser–Meyer–Olkin (KMO) test, Bartlett’s test of sphericity, and the Cronbach’s alpha test were also performed [81, 82]. The Cronbach’s alpha test was conducted to examine whether the variables of interest influenced the latent variables. The standard for evaluating the relevance of a model, which is expressed by the failed safety of a scale, is a value

exceeding 0.6 [83]. The KMO measure of sampling adequacy and Bartlett's test of sphericity were adopted to assess the reasonability of the exploratory factor analysis (EFA). The recommendations in this respect are $0.5 \leq KMO \leq 1$ and a significance <0.05 [81, 83].

3.5.2. Relative Autonomy Index

The subscales of the self-determination continuum are used as bases for quantitatively determining Relative Autonomy Index (RAI) and accordingly uncovering the level of autonomy exercised by an individual in a given activity or task. The RAI has been calculated using several scoring formulas that were developed by researchers on the basis of the self-determination continuum (Table 3.2). The first method involves using the behavioural regulation in exercise questionnaire (BREQ) to determine exercise behaviours and the stages of change occurring during exercise [84]. Here, the RAI calculation entails assigning negative weights to two types of controlled motivation (i.e., external: −2, and introjected: −1) and positive weights to two types of autonomous motivation (i.e., identified: +1, and intrinsic: +2). This method disregards amotivation and integrated regulation because amotivation items exhibit very high skewness; it is also difficult to empirically distinguish between integrated and identified regulation and between integrated and intrinsic regulation. In [85], an amotivation scale was incorporated into RAI measurement through BREQ-2 to measure the continuum of behavioural regulation in an exercise context. The scores of each indicator were weighted and then aggregated to form an RAI: amotivation (−3), external (−2), introjected (−1), identified (+2) and intrinsic (+3). The RAI can also be scored on the basis of the scores computed from all six motivational indicators in BREQ-2R [86]. Accordingly, intrinsic motivation was regarded as the highest form of self-determined motivation and was given a weight of +3; integrated, identified, introjected and external regulation and amotivation were

assigned weights of +2, +1, −1, −2 and −3, respectively.

Table 3.2. Formulas for measuring autonomy via the RAI.

No.	Study	Formula
1	[84]	RAI = ([External × −2] + [Introjected × −1] + [Identified × 1] + [Intrinsic × 2])
2	[85]	RAI = ([Amotivation × −3] + [External × −2] + [Introjected × −1] + [Identified × 2] + [Intrinsic × 3])
3	[86]	RAI = ([Amotivation × −3] + [External × −2] + [Introjected × −1] + [Identified × 1] + [Integrated × 2] + [Intrinsic × 3])

The approaches described above all assign different weights to the motivational indicators in SDT to measure autonomy in physical activity. Specifically, low autonomy levels (i.e., amotivation, external and introjected regulation) are accorded negative weights, whereas high autonomy levels (i.e., identified, integrated and intrinsic regulation) are given positive weights (a process regarded as conventional).

The choice of a specific RAI formula can be explained by two main reasons [87]. First, adopting different scoring protocols may yield additional insights pertinent to the optimal method of combining scores from various motivational instruments or determining which type of motivation is optimal as a key driver of a specific activity. Second, differences in RAI scoring protocols stem originally from context.

The necessity or concrete formula of an alternative index is discussed after the questionnaire results are presented.

3.5.3. Structural Equation Modelling

The author conducted structural equation modelling (SEM), which aligns with the aim of the study. SEM is a multivariate statistical technique through which

researchers scrutinise hypotheses regarding relationships between observed and latent variables [88] that are used to simultaneously explore a series of interrelated dependent relationships [89]. This technique has been widely used in numerous studies, particularly in determining links between correlation effects [90, 91].

The data collected in this work were analysed using the Statistical Package for the Social Sciences (25.0, IBM® SPSS®) and Amos software (IBM® SPSS®). All the variables in the questionnaires were examined through an initial exploratory factor analysis (EFA), reliability tests and confirmatory factor analysis (CFA) to verify the instruments' variable structures. EFA was used to analyse the relationships between correlated variables and reduce the data, which supported the confirmation of the proposed model's structure [92]. Principal axis factoring was frequently rotated to ease the interpretation of the extracted factors, and ProMax was used [93]. Factors with loadings less than 0.50 (the cut-off for significance) were regarded as weak indicators of the constructs and were thus excluded from the components [94]. Then, the empirical data were analysed using reliability tests, which were developed using the Cronbach's alpha test, the Kaiser–Meyer–Olkin (KMO) test and Bartlett's test [81, 82].

Next, the author performed CFA to test the adequacy of each scale employed to investigate the causal relationships among the variables [83]. To evaluate the goodness-of-fit (GoF) of the proposed model, indicators including the composite reliability (CR) for internal consistency reliability, the indicator loading for indicator reliability and the average variance extracted (AVE) for convergent validity were estimated [95, 96]. The adjusted structural equation model was examined to test the relationships between the study variables. The items on the various scales served as indicators of the latent variables in the model. In this regard, several indicators were taken into account, such as the chi-square (χ^2), the chi-square divided by degrees of

freedom (χ^2/df), the comparative fit index (CFI), the Tucker–Lewis index (TLI), the goodness-of-fit index (GFI), the Akaike information criterion (AIC) and the root mean square error of approximation (RMSEA) [88, 97, 98]. The thresholds of the indicators are provided in Table 3.3.

Table 3.3. Threshold of Goodness-of-fit assessment and model estimates

Indicator	**Recommended Level**
Cronbach's Alpha	>0.6 [83]
KMO Measure of Sampling Adequacy	$0.5 \leq KMO \leq 1$ [83]
Bartlett's Test of Sphericity	Sig. < 0.05 [81, 83]
Average Variance Extracted (AVE)	>0.5 [99]
Composite Reliability (CR)	>0.7 [95, 99]
Chi-Square/df (χ^2/df)	from 1 to 2 [100]
GFI	0 (no fit) to 1 (perfect fit) [92, 98]
CFI	0 (no fit) to 1 (perfect fit) [92, 98]
TFI	0 (no fit) to 1 (perfect fit) [92, 98]
NFI	0 (no fit) to 1 (perfect fit) [92, 98]
AIC	Smaller value [101]
RMSEA	<0.05, very good fit; 0.05–0.08, fairly good fit; 0.08–0.10, acceptable fit; >0.1, unacceptable fit [102]

3.5.4. Risk Mapping

This study used the risk mapping to measure severity level of each barrier to work motivation and its probability of occurrence in construction projects. The average value for responses to each barrier is calculated to find out its severity level and its probability of occurrence. The standard risk mapping matrix is a two-dimensioned matrix that classifies risks into three categories based on the combined effects of their frequency and severity [103]. This is a visual representation of each barrier's average severity and its probability of occurrence from the collected data, helps express in which risk zone each barrier falls. The matrix is 5x5 in size with the horizontal axis representing the frequency mean values (1–5), and the vertical axis representing the impact mean values (1–5). The matrix is coded based on a series of thresholds. Organizations use the thresholds to determine their risk level. There is no universal system for determining the point at which the probability of risk changes. The organization makes the decision to take action regarding anything with a score higher than a specific number and accept anything lower as insignificant enough to be ignored [104].

This study decided the limits of each zone were determined based on previous studies that applied the risk mapping [103, 104]. Accordingly, the low-risk zone would have a severity times frequency (SF) value from 1 to less than 10, the moderate-risk zone would have a value from 10 to less than 14, and the high-risk zone would have a value from 14 to 25. To calculate SF, the severity index (SI) and the frequency index (FI) are estimated by using mean value of each barrier. The SF provides better ranking results since it reflects the effects of each barrier and its probability of occurrence altogether. This way, the effect of each barrier to work motivation in construction projects is estimated more realistically. The SF will be calculated according to the equation as follows:

SF = Severity index (SI) x Frequency index (FI)

Accodingly, three main zones are presented in the risk matrix [103-105] such as: (1) Low-risk zone: low-risk levels due to their low severity and frequency, and can be ignored; (2) Moderate-risk zone: barriers that require a reasonable level of attention due to their moderate level of occurrence and severity; if these things happen, one can cope with them and move on. However, if their probability of occurrence is moderate; it should be reduced and if their impact is moderate, it should be controlled and reduced and a contingency plan should be in place just in case they do; and (3) High-risk zone: barriers in this zone are of high severity; barriers that require an immediate and high level of controlling and solving due to their severity and frequency of occurrence.

Chapter 4. Importance of Autonomous Motivation in Construction Labor Productivity Improvement: A Self-Determination Theory Perspective

4.1. Introduction

Research on CLP is an important domain with which numerous researchers worldwide have been concerned [106]. Many studies have investigated issues related to worker productivity, identifying various motivational factors that affect the productive capacity of construction laborers. While many previous studies have emphasized the role of controlled motivation (i.e., external factors) in CLP enhancement [107-110], only one study [76] has mentioned autonomous motivation (i.e., internal factors) to date, but the authors did not explain how autonomous motivation can be generated and maintained. In this regard, construction practitioners and managers in Vietnam claimed that autonomous motivation plays an important role in enhancing work performance [32, 33]. Specifically, workers may tend to enthusiastically work when they feel a sense of voluntary action without micromanagement from their managers, which may promote work motivation to achieve the highest work performance. In addition, they perceive that empowering plays a key role in enhancing work motivation and performance; hence, some managers are willing to offer more authority to their workers as long as they ensure desirable work outcomes. However, no study has provided empirical evidence to demonstrate these circumstances. This leads to ambiguity in both the research community and the industry regarding the practical importance of autonomous motivation as well as the role of leadership style in motivation and performance enhancement through the psychological aspect. An essential task, therefore, is to examine the role of the autonomous motivation of construction practitioners in CLP

enhancement through empirical evidence. It is also vital to determine how autonomous motivation can be generated and maintained by integrating a reasonable leadership style and psychological satisfaction.

The above-mentioned requirements can be satisfied using self-determination theory, which offers theoretical support for new leadership approaches (e.g., engaging leadership) through theories on basic psychological needs (BPNs) and organismic integration [42, 111]. In accordance with these perspectives, the leadership of an organization should foster a work environment that satisfies employees' essential psychological needs for autonomy, competence, and relatedness. In the SDT framework, the satisfaction of BPNs is assumed to represent the underlying motivational mechanism that energizes and directs people's behaviors (a type of work engagement) [44]. Such satisfaction is regarded as the essential nutrient in individuals' optimal functioning and well-being, similar to how water, minerals, and sunshine are essential for plants to bloom [44, 52]. SDT postulates the existence of psychological satisfaction, which is important in individual motivation, growth, and performance [36, 37].

Despite the promise of SDT for such investigations, however, there appears to be a gap in extant knowledge because of the aforementioned lack of comprehensive exploration into the simultaneous effects of leadership and psychological and motivational factors on work performance. To fill these voids, the author empirically investigated an integrated research model to exhaustively represent the psychological, and motivational determinants of CLP in the leadership context on the basis of SDT. Understanding these factors can support the development of strategies for reducing inefficiencies, effectively managing the construction workforce, and practicing cost-effective construction. These outcomes, in turn, would help contractors to improve project performance and become more competitive, thereby increasing their chances

of survival in this highly competitive industry [112, 113].

4.2. Research Objectives

To achieve the aim of this study, the author pursued the following objectives:

- Exploring the relationships between engaging leadership and three pathways to BPN satisfaction among workers: autonomy satisfaction (AS), competence satisfaction (CS), and relatedness satisfaction (RS);
- Exploring the relationships between these satisfaction pathways and worker motivation, as well as the effects of these relationships on productivity;
- Exploring the associations between motivational factors and work engagement and the latter's links to productivity;
- Formulating recommendations for improving CLP.

4.3. Research Hypotheses Development

4.3.1. The relationship between engaging leadership and three basic psychological needs satisfaction

With regard to the relationship between leadership and BPNs, researchers [43, 114-116] have consistently emphasized the critical role that leaders play in fostering positive work environments, where employee motivation is nurtured and nourished through BPN fulfillment. A study demonstrated that EL passively contributed to the satisfaction of the three BPNs of employees in technical engineering organizations [42]. Another study explored the positive relationship between AS and EL in the health system of a multinational organization [117].

To date, however, no study has examined the link between EL and the satisfaction of BPNs in the construction sector. The author therefore inquired into whether a positive relationship exists between EL and the satisfaction of the three

BPNs among workers for the following reasons. First, construction managers/leaders empower their workers by giving them important responsibilities and the freedom to handle situations as they feel best and by actively encouraging them to formulate their own opinions in decision making (i.e., practice empowerment in accordance with EL). Workers are expected to satisfy their autonomy more easily when they are allowed and motivated to take initiative, be creative, learn from mistakes, assume responsibilities, and handle difficult situations that they encounter in their designated tasks in their own ways. Second, construction managers/leaders can support workers in endeavors to improve or strengthen their practical skills and first-hand experiences by providing adequate feedback and encouraging them to question ways of solving problems (i.e., practice strengthening in the manner advocated in the EL concept). This measure can help workers to enhance their competencies, growth, and development, which in turn advances the satisfaction of their competence. Third, construction managers/leaders can cultivate a positive work environment by building good relationships and communications with their workers, as well as among workers in teams (i.e., establish connections in accordance with the principles of EL). This course of action can enhance interrelationships, collaboration, and support among teammates, thus contributing to a sense of belongingness in teams and satisfying their relatedness needs. Based on this discussion, the author proposes the following hypotheses:

Hypothesis 1a (H1a). EL is positively associated with the AS of construction workers on sites.

Hypothesis 1b (H1b). EL is positively associated with the CS of construction workers on sites.

Hypothesis 1c (H1c). EL is positively associated with the RS of construction workers on sites.

4.3.2. The relationship between three basic psychological needs satisfaction and construction labor productivity

AS refers to the psychological need to experience self-determination and endorse the cause of behaviour as one's own [118]. SDT regards AS as a psychological necessity and a requirement for self-regulation, which determines the extent to which employees are willing to commit themselves to their tasks and work roles [43, 50, 119]. The author expected to find support for the link between the need for AS and the labour productivity of construction workers on sites because three psychological components can explain why autonomy predicts work performance [120]. First, an internal perceived locus of causality is associated with productivity because this association enables an individual to take ownership of an action/circumstance. AS predicts productivity outcomes, given that increasing (versus decreasing) productivity affirms the controllability of an environment by an individual. Second, researchers [121] found that perceived volition—the perception that behaviour is self-initiated and free of coercion—links autonomy to work performance, considering that individuals will not expend effort if they believe that such initiatives will be thwarted or ineffective. Third, the more strongly one's sense of freedom to make work-related decisions and the more meaningful and correspondent activities are with one's interests, the greater the desire to engage in one's work, take initiative and be creative [122]. The upshot of all these is increased work performance [122]. When workers perceive that they have freedom of choice regardless of whether they engage in a performance task, their productivity improves. This argument is also applicable to the construction sector.

CS pertains to the desire to demonstrate and improve one's abilities [44]. When an individual's productivity criteria cannot be evaluated, effort and productivity stagnate (presumably because of a lack of competence-relevant feedback) [123]. In

this regard, the author anticipated CS to predict worker productivity on sites because demonstrating and improving one's abilities is fundamentally satisfying. Workers satisfied with their competence work more effectively, thus enhancing their productive capacity. As found in some studies [124, 125], a positive association exists between CS and task performance. In a similar vein, a relationship between CS and CLP can be assumed for the following reasons: Competence perceptions depend on a mix of challenge and skill; workers must both experience a challenge and possess the skills necessary to meet this challenge. Workers who feel unchallenged are prevented from elevating their sense of proficiency because there is no work involved in satisfying demand (even if a task is self-endorsed). Conversely, workers who are overchallenged may feel incompetent given the overwhelming nature of a task. Generally, productivity improves under challenging (yet attainable) tasks that serve to boost levels of perceived competence. Perceptions regarding competence also depend on the productivity feedback provided by supervisors or teammates on sites. Workers must feel they are responsible for behaviours to which feedback is directed [126, 127], and such feedback must come from a trusted source [128]. Appropriate feedback (and, subsequently, perceived competence) affects productivity in required tasks on sites. The arguments that CS is cultivated by challenge and appropriate feedback and that CS leads to elevated worker productivity are likewise expected to hold with respect to the construction sector.

Concerning RS, numerous researchers have stated that good relationships have a significant effect on labour productivity [129-135]. Accordingly, the author expected to find that when workers' relatedness is satisfied by valuable interpersonal relationships with teammates, the relationships generate positive emotions and increase cognitive processing. These effects naturally induce and augment the will to enact what is required to preserve valuable ties and act in favour of them, that is,

being helpful and improving productivity. This argument finds empirical support in [136], which revealed that a good relationship among project stakeholders may affect construction performance by creating a better work environment. In addition, several studies on the quality of relationships with supervisors or among workers have found that such quality relates to their productivity [137, 138]. Other researchers [139, 140] explained that deliberate attempts to establish controlling relationships or witnessing acts of rudeness by an authority figure/peer reduces work performance. By contrast, meeting relatedness needs augments worker productivity on sites, in part because it improves well-being. Fostering secure emotional attachments is associated with holistic, integrated functioning, as is the case with fostering prosocial orientations and promoting healthy relationships with others [141]. Alternatively, this may occur through its positive impact on intrinsic motivation, which in turn, predicts productivity [142]. These RS- and worker productivity-related issues are applicable to the construction sector. On the basis of the aforementioned rationale and supporting evidence, the author puts forward the suppositions below:

- *Hypothesis 2a (H2a): AS is positively associated with worker productivity on sites (represented by CLP).*
- *Hypothesis 2b (H2b): CS is positively associated with CLP.*
- *Hypothesis 2c (H2c): RS is positively associated with CLP.*

4.3.3. The relationship between work motivation and three basic psychological needs satisfaction

The relationships between work motivation and BPNs are consistent, considering that SDT posits BPN satisfaction as underlying motivation [52]. These relationships were examined in prior studies on issues such as academic engagement [57], physical exercise [143] and health care [144]. Accordingly, the author

hypothesised favourable relationships between the psychological satisfaction and work motivation of construction workers on sites on the basis of SDT. To begin with, psychological satisfaction contributes to autonomous motivation because, as demonstrated in [144, 145], the satisfaction of autonomy, competence and relatedness needs facilitates intrinsic motivation, which is the highest type of AM in SDT. Other researchers [146] confirmed that psychological satisfaction advances AM, which subsequently engenders elevated enjoyment and value, as well as reduced academic pressure; specifically, among autonomy, competence and relatedness, the third factor is the greatest contributor to AM. Furthermore, the researchers in [146] found that competence satisfaction positively predicts CM but that the satisfaction of autonomy and relatedness is negatively related to CM. The work in [147] indicated that introjected regulation is positively correlated with autonomy, competence and relatedness and that external regulation is not significantly correlated with the three psychological needs. Finally, the authors of [42] explained that the satisfaction of autonomy, competence and relatedness negatively contributes to amotivation, which is the lowest degree of self-determination along the continuum. Logically, the non-satisfaction of individuals' psychological needs exerts unfavourable effects on work motivation, resulting in a lack of drive to participate in activities. Hence, it is reasonable to assume that psychological satisfaction contributes to amotivation, AM and CM. For this reason, the author maintains the following:

- *Hypothesis 3 (H3). For construction workers, (H3a) AS is positively associated with AM, (H3b) AS is positively associated with CM and (H3c) AS is negatively associated with amotivation.*
- *Hypothesis 4 (H4). For construction workers, (H4a) CS is positively associated with AM, (H4b) CS is positively associated with CM and (H4c) CS is negatively associated with amotivation.*

- *Hypothesis 5 (H5). For construction workers, (H5a) RS is positively associated with AM, (H5b) RS is positively associated with CM and (H5c) RS is negatively associated with amotivation.*

4.3.4. The relationship between work motivation and construction labor productivity

The effects of work motivation on CLP according to SDT were discussed in a recent study. Specifically, in [76], the authors demonstrated that identified regulation (a type of AM) significantly affected worker productivity on sites. In addition, they found that extrinsic regulation and introjected regulation (types of CM) significantly influenced construction workers' productivity. This finding makes sense, as salary, reward, and job security are key factors that encourage workers to make an effort to enhance their productivity [109]. Finally, amotivation negatively affects worker productivity on sites, because when amotivation as work motivation increasingly diminishes, worker productivity starts decreasing [76]. Thus, it is reasonable to suppose the existence of relationships between STD-based motivational factors and worker productivity. In line with this argument, the author proposes the following hypotheses:

- *Hypothesis 6 (H6). AM is positively associated with CLP.*
- *Hypothesis 7 (H7). CM is positively associated with CLP.*
- *Hypothesis 8 (H8). Amotivation is negatively associated with CLP.*

4.3.5. The relationship between work motivation and work engagement

Numerous studies have probed into the role of motivation in engagement among individuals of various occupations, such as athletes [148], volunteers [149] and industrial employees [150]. These studies showed that highly autonomously

motivated employees exhibit more engagement behaviours than their CM counterparts [148-150]. In technical engineering organisations, amotivation is negatively correlated with the WE of employees [42]. CM measures, particularly monetary rewards and bonuses, aid in increasing motivation among employees who perform a job or task that requires typically repetitive and unpleasant mechanical skills [151]. As indicated in [152], rewards appear to be the most reliable indicator of employee WE. Certain studies have shown that autonomously motivated employees are more physically, emotionally and cognitively engaged in challenging and meaningful tasks in the workplace [153] and that they render more productive work and perform better [154]. According to [155, 156], AM drives a person towards greater cognitive effort, which is related to absorption, one of the dimensions of WE [155, 156]. In this regard, workers should be encouraged to achieve a higher degree of self-determined motivation for them to face challenging tasks. Although no study has been directed at the relationship between each type of motivation and WE in the construction sector, the insights above are considered applicable to the construction sector. Therefore, the author examines these relationships with the following suppositions as grounding:

- *Hypothesis 9 (H9). AM has a positive association with the WE of construction workers.*
- *Hypothesis 10 (H10). CM has a positive association with the WE of construction workers.*
- *Hypothesis 11 (H11). Amotivation has a negative association with the WE of construction workers.*

4.3.5. The relationship between work engagement and construction labor productivity

Work performance is made up of distinct sets of activities that contribute to an organisation in various ways [157]. Considering this attribute, a critical requirement is to consider how various aspects of job performance may be influenced by WE [79]. Theoretical research has linked investment in the three energies of WE to job performance. First, investing physical energy (i.e. behaviours) in work roles moves the realisation of organisational goals along by allowing employees to perform organisationally valued behaviours at higher levels of effort over longer periods of time [54, 158]. This phenomenon is ascribed to the fact that people's work roles are largely defined by the behavioural expectations of others in their organisations [159]; investing physical energy in role accomplishment elevates the likelihood of meeting these expectations and, thus, judgments that a role holder is a positive contributor to an organisation. These arguments are supported by [160], who discovered that multiple samples of employees who work harder perform better on the job. Second, investing cognitive energy in work roles contributes to the achievement of organisational goals by encouraging more vigilant, attentive and focused behaviours [54]. The researchers in [161] used the term 'needfulness' to label behaviours that share these characteristics, and they noted that when needfulness declines because of reductions in cognitive energy investments, performance decrements result from failures to see, take note of or be attentive to one's work roles. Finally, emotional investments in work roles contribute to organisational goals in a variety of ways [54]. Those who invest emotional energy in their roles improve performance via the encouraged deeper connection among co-workers in pursuit of organisational goals [162]. Such an investment also aids individuals in meeting the emotional demands of their roles in a more complete and authentic manner [54, 158].

On construction sites, workers face a variety of challenges, such as conflicts, accidents and disagreements. Different workers react differently to these situations, which not only affects their productivity but also hinders the performance of others [163]. Certain research on CLP improvement concentrated on workers' behaviours (i.e. physical engagement) on sites. An example is the work of [163], who found that behaviour is positively and directly associated with worker performance; contractors should thus concern themselves with enhancing positive worker behaviours to improve CLP. In accordance with these ideas, the author postulates that *WE is positively associated with CLP [Hypothesis 12 (H12)].*

Table 4.1 summarises the hypotheses tested in this study.

Table 4.1. The hypotheses of the study 1

H	Path	References
H1a	Engaging Leadership (EL) → Autonomy Satisfaction (AS)	[42, 117]
H1b	Engaging Leadership (EL) → Competence Satisfaction (CS)	[42]
H1c	Engaging Leadership (EL) → Relatedness Satisfaction (RS)	[42]
H2a	Autonomy Satisfaction (AS) → CLP	[116, 122, 124]
H2b	Competence Satisfaction (CS) → CLP	[116, 122, 124]
H2c	Relatedness Satisfaction (RS) → CLP	[116, 122, 124]
H3a	Autonomy Satisfaction (AS) → Autonomous Motivation (AM)	[42, 57, 146, 147]
H3b	Autonomy Satisfaction (AS) → Controlled Motivation (CM)	[42, 146, 147]
H3c	Autonomy Satisfaction (AS) → Amotivation (Amot)	[42]
H4a	Competence Satisfaction (CS) → Autonomous Motivation (AM)	[42, 57, 146, 147]
H4b	Competence Satisfaction (CS) → Controlled Motivation (CM)	[42, 146, 147]
H4c	Competence Satisfaction (CS) → Amotivation (Amot)	[42]
H5a	Relatedness Satisfaction (RS) → Autonomous Motivation (AM)	[42, 57, 146, 147]
H5b	Relatedness Satisfaction (RS) → Controlled Motivation (CM)	[42, 146, 147]
H5c	Relatedness Satisfaction (RS) → Amotivation (Amot)	[42]
H6	Autonomous Motivation (AM) → CLP	[76]
H7	Controlled Motivation (CM) → CLP	[76, 109, 152]
H8	Amotivation (Amot) → CLP	[76]
H9	Autonomous Motivation (AM) → Work Engagement (WE)	[57, 62, 148-150, 164]
H10	Controlled Motivation (CM) → Work Engagement (WE)	[149, 150]
H11	Amotivation (Amot) → Work Engagement (WE)	[42, 150]
H12	Work Engagement (WE) → CLP	[150, 152, 160, 163]

It should be noted that, only three studies of [76, 109, 163] were set in the construction sector; whereas, [42] in engineering organizations; [117] in healthcare organizations; [122] in technological organizations; [57, 62, 124, 146, 147] in education; [116] in financial organizations; [152] in hotel companies; [148] in sport field; [150] in service companies; [149] in volunteer work; [160] in supply companies; and [164] in multidisciplinary;

The structural model of the research is presented in Figure 4.1.

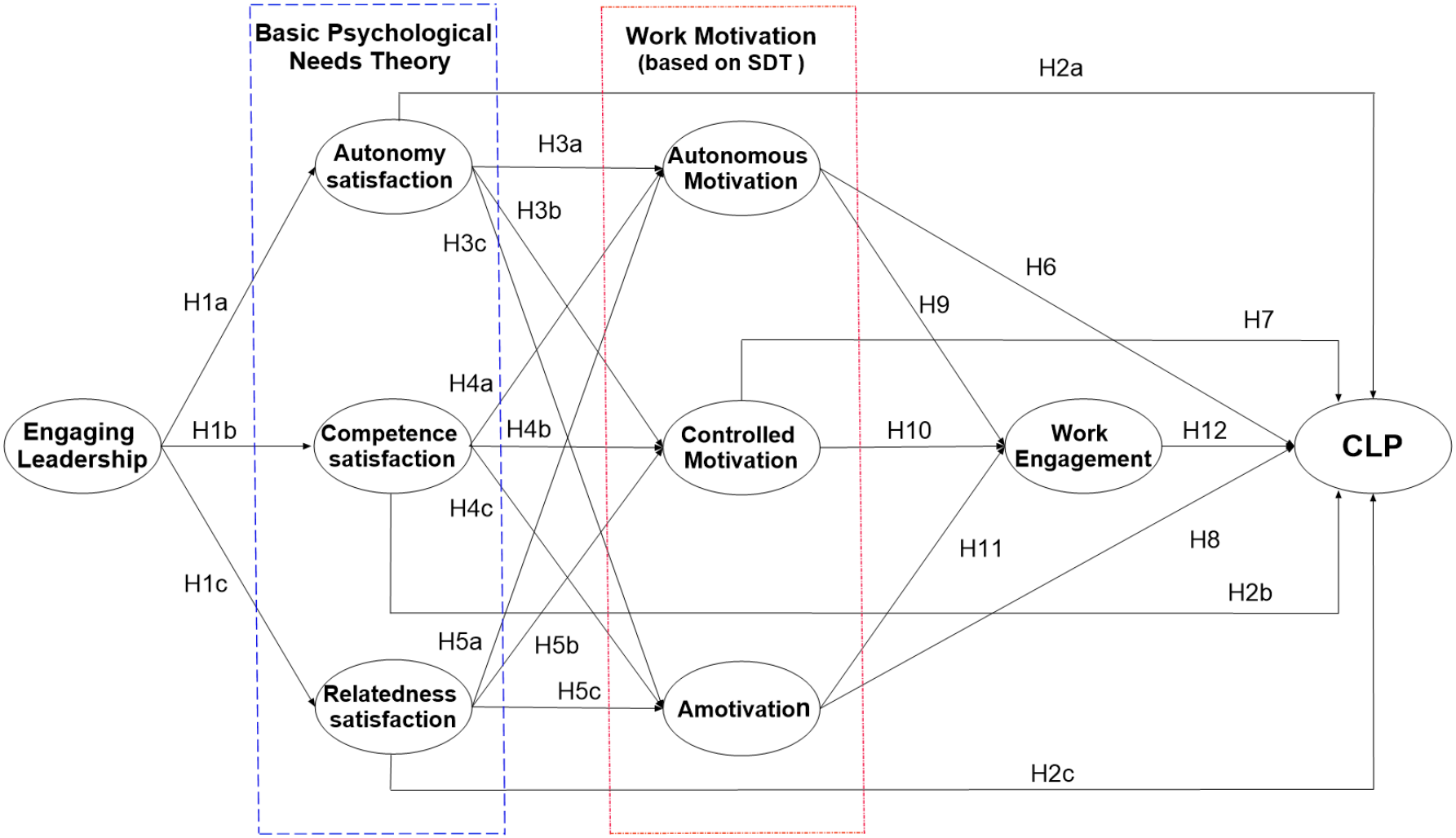

Figure 4.1. Structural model of the study 1

4.4. Results

4.4.1. Preliminary Analysis

This study tested a measurement model with all nine latent variables related to their respective indicators in the preliminary analysis. The skewness and kurtosis values were less than 2.0, which is within an acceptable range [165]. The mean values, standard deviations and correlations between the variables are listed in Table 4.2. As theoretically supported and expected, EL was correlated with BPN satisfaction (e.g. EL and AS were correlated, $r = 0.334$ and $p < 0.01$). As anticipated, the satisfaction of two BPNs was correlated with worker productivity (e.g. CS and CLP were correlated, $r = 0.480$ and $p < 0.01$; RS and CLP were correlated, $r = 0.422$ and $p < 0.01$). CS and RS were correlated with work motivation (e.g. CS and AM were correlated, $r = 0.382$ and $p < 0.01$; CS and CM were correlated, $r = 0.447$ and $p < 0.01$; RS and AM were correlated, $r = 0.322$ and $p < 0.01$; RS and CM were correlated, $r = 0.269$ and $p < 0.01$). As shown in Table 4.2, work motivation was correlated with WE onsite (e.g. AM and WE were correlated, $r = 0.321$ and $p < 0.01$; CM and WE were correlated, $r = 0.240$ and $p < 0.01$). Furthermore, work motivation was correlated with productivity (e.g. AM and CLP were correlated, $r = 0.502$ and $p < 0.01$; CM and CLP were correlated, $r = 0.441$ and $p < 0.01$). As anticipated, WE correlated with CLP ($r = 0.394$, $p < 0.01$).

To complete the preliminary analyses, the author probed into whether demographic attributes (i.e. gender, age, educational level, work experience, marital status, income and BMI) were associated with EL, the three BPNs, work motivation, WE and worker productivity. As reflected in Table 4.2, gender was uncorrelated with all the latent variables; age was correlated only with AS ($r = 0.168$, $p < 0.05$); educational level was correlated only with amotivation ($r = –0.186$, $p < 0.05$); work experience was correlated only with AS ($r = 0.154$, $p < 0.05$); marital status was correlated only with AS ($r = 0.157$, $p < 0.05$); BMI was correlated only with AS ($r = 0.210$, $p < 0.01$); and income was

correlated only with WE ($r = –0.160$, $p < 0.05$). No correlations were found between all the demographic variables and CLP; hence, the final structural model was presented without the control variables.

Table 4.2. Means, standard deviations and correlations between variables

	Mean	SD	Gender	Age	Edu	Experience	Marital	BMI	Income	EL	AS	CS	RS	Amot	AM	CM	WE	CLP
Gender[1]	1.130	0.337	1.000															
Age	30.605	6.995	.123	1.000														
Edu[2]	2.893	0.872	–.217**	.018	1.000													
Experience	5.616	3.593	–.156*	.620**	.186**	1.000												
Marital[3]	1.767	0.423	.115	.634**	.015	.474**	1.000											
BMI[4]	22.260	2.013	–.307**	.148*	.101	.052	.074	1.000										
Income[5]	3.811	0.520	–.088	.434**	.353**	.468**	.249**	.145*	1.000									
EL	3.389	0.663	–.041	.035	.025	–.007	–.007	.053	.066	1.000								
AS	3.467	0.855	–.030	.168*	.087	.154*	.157*	.210**	.068	.334**	1.000							
CS	3.487	0.809	–.027	.044	.020	–.020	–.066	.015	.002	.011	–.054	1.000						
RS	3.349	0.997	–.042	–.009	.026	–.119	.017	.074	.016	.042	.022	.363**	1.000					
Amot	1.825	0.367	.118	.022	–.186**	–.107	.104	.038	–.089	–.048	–.074	.033	–.012	1.000				
AM	3.384	1.034	–.131	–.022	.004	–.092	–.031	.108	.008	.052	–.091	.382**	.322**	–.005	1.000			
CM	3.624	0.870	.085	.014	.005	–.114	.029	.029	–.075	–.057	–.061	.447**	.269**	.053	.408**	1.000		
WE	3.526	1.094	–.093	–.072	–.015	–.098	–.011	–.006	–.160*	.037	.071	.371**	.315**	–.027	.321**	.240**	1.000	
CLP	3.428	0.970	–.082	.000	.028	–.127	.112	.077	–.051	–.016	–.058	.480**	.422**	.026	.502**	.441**	.394**	1.000

[1] Gender is a dummy variable that takes the value of 1 when the subject is male and 2 when female.

[2] Education level is a dummy variable that takes the value of 1 for no education, 2 for primary school, 3 for secondary school and 4 for high school and above.

[3] Marital status is a dummy variable that takes the value of 1 when the subject is single and 2 when married.

[4] BMI is the body mass index, which is calculated by weight in kilograms divided by the square of height in meters [85].

[5] Yearly average income = 1000 USD (1 USD = 22,952.5 VND); SD = standard deviation; * $p < 0.05$; ** $p < 0.01$.

4.4.2. Measurement Model

With the original version of the scale, this study applied an approach to data analysis similar to EFA [166]. As shown in Table 4.3, the nine latent variables emerged with initial eigenvalues greater than 1. These variables explained 73.138% of the variance. Their Cronbach's alpha values were above 0.70, indicating the high reliability of the nine dimensions [83]. The KMO test results showed a coefficient value of 0.844, thus >0.5, indicating a strong measure of sampling adequacy [83]. This explains why partial correlations or multicollinearity structures among the factors were sufficient to justify the grouping of the variables into related sets for the extraction of the nine principal components. Additionally, Bartlett's test of sphericity is 6053.051, and the corresponding significance probability is $p = 0.000$, which shows that the correlation matrix is not an identity matrix and that there are relationships among all variables (rejection of null hypothesis). The findings bolstered the dependability and validity of the nine principal components derived from the observed variables [81, 83].

Table 4.3. Evaluation of constructs in the measurement model.

Code	Component								
	EL	AS	WE	AM	CM	RS	CS	Amot	CLP
EL3	0.914								
EL12	0.893								
EL1	0.889								
EL9	0.883								
EL11	0.846								
EL8	0.846								
EL10	0.836								
EL6	0.833								
AS4		0.934							
AS2		0.932							
AS3		0.912							
AS1		0.907							
AS5		0.882							

Code	Component								
	EL	AS	WE	AM	CM	RS	CS	Amot	CLP
WE3			0.905						
WE7			0.840						
WE9			0.619						
WE8			0.609						
Intri1				0.782					
Intri6				0.781					
Intri4				0.714					
Intri5				0.672					
Exter7					0.801				
Exter2					0.699				
Exter8					0.644				
Exter9					0.636				
RS1						0.752			
RS5						0.746			
RS3						0.695			
RS6						0.664			
CS5							0.805		
CS6							0.724		
CS4							0.671		
CS2							0.571		
Amot3								0.894	
Amot4								0.745	
Amot1								0.577	
LP3									0.817
LP1									0.761
LP5									0.712
Initial Eigenvalues	7.686	7.350	3.435	2.151	1.913	1.832	1.666	1.329	1.163
% of Variance	19.707	18.845	8.807	5.514	4.906	4.696	4.271	3.408	2.983
Cumulative %	19.707	38.553	47.360	52.874	57.780	62.477	66.747	70.155	73.138
Cronbach’s Alpha	0.960	0.962	0.839	0.841	0.806	0.813	0.804	0.774	0.844
Kaiser–Meyer–Olkin Measure of Sampling Adequacy	0.844								

Code	Component								
	EL	AS	WE	AM	CM	RS	CS	Amot	CLP
Bartlett's Test of Sphericity									
Approx. Chi-Square	6053.051								
df	741								
Sig.	0.000								
Composite Reliability (CR)	0.959	0.959	0.839	0.831	0.756	0.813	0.805	0.785	0.831
Average Variance Extracted (AVE)	0.743	0.825	0.572	0.552	0.508	0.521	0.508	0.559	0.622
Note: All factor loadings below 0.50 were excluded.									

CFA was conducted to evaluate the measurement model, which encompassed the nine correlated latent variables. As shown in Table 4.3, the CR values of the variables were 0.959, 0.959, 0.839, 0.831, 0.756, 0.813, 0.805, 0.785, and 0.831. These are greater than the measurement model's threshold of 0.7, indicating the acceptable consistency and reliability of the model [95, 99]. The AVE values of the variables were 0.743, 0.825, 0.572, 0.552, 0.508, 0.521, 0.508, 0.559, and 0.622, indicating a high degree of convergent validity, considering they all exceed 0.5 [99].

Before testing the hypotheses, the author performed a series of CFAs to ensure the adequacy of each scale, obtaining various reliability indices and calculating descriptive statistics and correlations [167]. Maximum likelihood estimation methods were adopted, and each model's GoF was measured using absolute and relative indices [168]. The fit of the structural model with respect to the data was examined with χ^2/df, CFI, TLI, GFI and RMSEA. The CFA shows the following results: χ^2/df = 1.790, CFI = 0.908; TLI = 0.898, GFI = 0.789, NFI = 0.816, AIC = 1419.83, RMSEA = 0.061. These findings verified that the measurement model, which included covariances among all the constructs, fitted the data satisfactorily [103,112,114,116].

4.4.3. Assessment of the Structural Model

Because the proposed structural model was hypothetically represented on the basis of previous research findings and/or theoretical expectations, it should meet the standard indices of model fit [169]. As shown in Table 4.4, the final structural model acceptably fit the data, and it overall performed better than the initial model, as evidenced by the following values: χ^2/df =1.850, CFI = 0.899; TFI = 0.890; GFI = 0.778; NFI = 0.806; AIC = 1.458.08, RMSEA = 0.063. These results demonstrated that all the fit indices satisfied the criteria; thus, the values of the final fit indices in the final structural model suggested that the improved version was interpretable. These findings also confirmed the validity and reliability of the measurement model. Figure 4.2 and Table 4.5 provide the regression weights for the final structural model, which solidly supported the hypothesized model.

Table 4.4. Goodness-of-fit.

Indicator	Recommended Level	Initial Model	Final Model
χ^2/df	from 1 to 2 [100]	1.823	1.850
CFI	0 (no fit) to 1 (perfect fit) [92, 98]	0.673	0.899
TFI	0 (no fit) to 1 (perfect fit) [92, 98]	0.662	0.890
GFI	0 (no fit) to 1 (perfect fit) [92, 98]	0.553	0.778
NFI	0 (no fit) to 1 (perfect fit) [92, 98]	0.486	0.806
AIC	Smaller value [101]	5938.987	1.458.08
RMSEA	<0.05, very good fit; 0.05–0.08, fairly good fit 0.08–0.10, acceptable fit; >0.1, unacceptable fit [102]	0.062	0.063

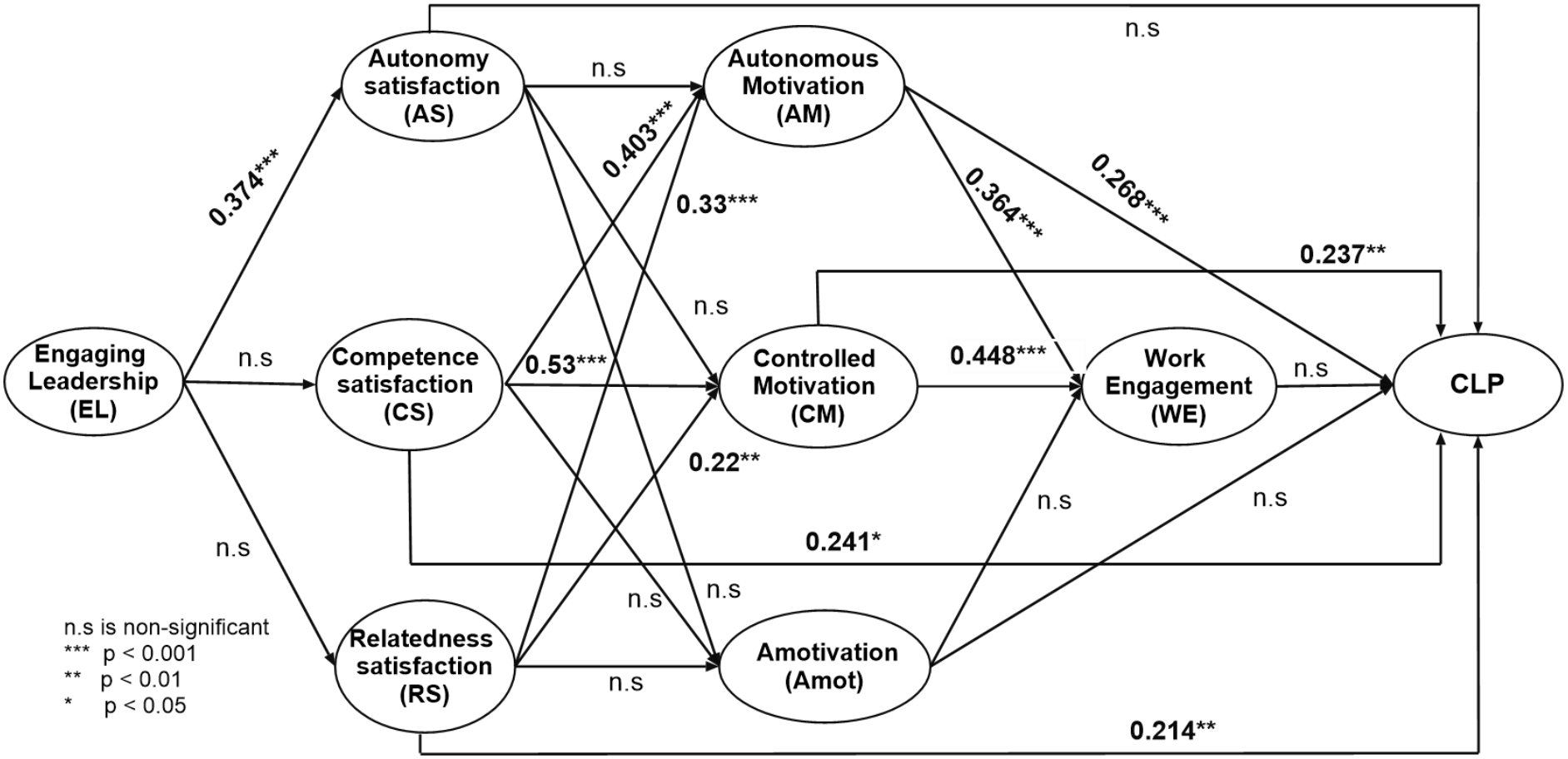

Figure 4.2. Regression weights for the final structural model

Table 4.5. Regression weights for the final structural model

H	Path	β	*p*	Remark	Comparison with Other Findings	
					Construction Field	Non-Construction Fields
H4b	CS → CM	0.530	***	The first feature	-	(+) E.O. [42]; (n.s.) Edu. [146]; (n.s.) Edu. [147]
H5b	RS → CM	0.220	0.001		-	(n.s.) E.O. [42]; (–) Edu. [146]; (n.s.) Edu. [147]
H7	CM → CLP	0.237	0.020		(+) [76]; (+) [109]	(+) H.C. [152]
H10	CM → WE	0.448	***		-	(–) V.W. [149]; (+) S.C. [150]
H3c	AS → Amot	–0.029	0.469		-	(–) E.O. [42]
H4c	CS → Amot	0.047	0.319		-	(–) E.O. [42]
H5c	RS → Amot	0.013	0.742		-	(–) E.O. [42]
H8	Amot → CLP	0.002	0.987		(–) [76]	-
H11	Amot → WE	–0.262	0.186		-	(–) E.O.[42]; (n.s.) S.C. [150]
H2b	CS → CLP	0.241	0.023	The second feature	-	(+) T.O. [122]; (+) Edu. [124]; (+) F.O. [116]
H2c	RS → CLP	0.214	0.005		-	(+) T.O. [122]; (+) Edu. [124]; (+) F.O. [116]
H4a	CS → AM	0.403	***		-	(+) E.O. [42]; (+) Edu. [146]; (+) Edu. [57]; (+) Edu. [147]
H5a	RS → AM	0.330	***			(n.s.) E.O. [42]; (+) Edu. [146]; (+) Edu. [57]; (+) Edu.[147]
H6	AM → CLP	0.268	***		(+) [76]	-
H9	AM → WE	0.364	***		-	(+) Edu. [57]; (+) S. [148]; (+) S.C. [150]; (+) V.W. [149]; (+) M. [164]; (+) Edu. [62]

H	Path	β	*p*	Remark	Comparison with Other Findings	
					Construction Field	Non-Construction Fields
H1a	EL → AS	0.374	***	The third feature	-	(+) E.O. [42]; (+) H.O. [117]
H1b	EL → CS	–0.051	0.533		-	(+) E.O. [42]
H1c	EL → RS	0.046	0.653		-	(+) E.O. [42]
H2a	AS → CLP	–0.044	0.512		-	(+) T.O. [122]; (+) Edu. [124]; (+) F.O. [116]
H3a	AS → AM	–0.134	0.090		-	(+) E.O. [42]; (n.s.) Edu. [146]; (+) Edu. [57]; (+) Edu. [147]
H3b	AS → CM	–0.043	0.526		-	(–) E.O. [42]; (–) Edu. [146]; (n.s.) Edu. [147]
H12	WE → CLP	0.069	0.195	The fourth feature	(+) [163]	(+) H.C. [152]; (+) S.C. [150]; (+) Su.C. [160]

Notes: (+) denotes a positive impact, (–) indicates a negative impact, and (n.s.) denotes a non-significant impact. E.O. pertains to engineering organizations. H.O. stands for healthcare organizations. T.O. represents technological organizations. Edu. stands for the education field, and F.O. denotes financial organizations. H.C. refers to hotel companies, and S. is for the sport field. S.C. refers to service companies, and Su.C. refers to supply companies. M. means multidisciplinary, and V.W. refers to volunteer work. *** $p < 0.001$.

4.5. Discussions

As highlighted in Table 4.5, the results of the SEM suggested the existence of several valuable features in CLP improvement, as follows.

4.5.1. First Feature: The Roles of Controlled Motivation and Amotivation in CLP Improvement (Conventional View)

When aiming to improve CLP, promoting work motivation plays an important role [108]. In this regard, previous studies have emphasized the role of enhancing controlled motivation (i.e., external factors such as salary, reward, or punishment) and reducing amotivation (i.e., lack of motivation) in CLP improvement [107-110]. In this research, as shown in Table 4.5, CM exerted positive and significant effects on CLP (H7; $\beta = 0.237$, $p < 0.05$), whereas amotivation did not significantly influence this respect (H8). These results reinforce the findings from previous studies, which explained the significant role of CM in enhancing CLP. In addition, the studies of [60,63,123,124] indicated that it was vital to promote and reward construction laborers to enhance motivation and ultimately improve labor productivity. Furthermore, construction practitioners acknowledged that being rewarded was a clear sign that their abilities were recognized [110, 170].

In the construction sector in many developing countries, such as Vietnam, the effectiveness of external factors has been regarded as a means of improving CLP. In other words, factors such as on-time payment, amount of salary, or financial reward are significant elements in motivating workers to participate in tasks [29]. A study conducted in the construction sector illustrated that CM enhances worker productivity. Specifically, in [76], it was explained that workers believe they must prove their worth to themselves for them to feel satisfied and proud of themselves. Otherwise, they fear that they will elicit negative and discouraging thoughts and feelings. They

tend to carry out their responsibilities in response to extrinsic regulation to gain respect from their peers, teammates, and supervisors. They also worked hard to avoid negative comments and criticism.

In summary, the findings reinforced the conventional view and emphasized the role of CM in CLP enhancement. However, another aspect of work motivation (i.e., AM) should be carefully considered to examine its role in improving CLP. This view is addressed in the next section.

4.5.2. The Second Feature: The Role of Autonomous Motivation in CLP Improvement

In the current research, the author found that AM positively and significantly contributed to CLP (H6; $\beta = 0.268$, $p < 0.001$), as depicted in Table 4.5. This finding revealed that AM played an important role in CLP enhancement, consistent with [76], which explained that identified regulation, i.e., a type of AM, significantly affected worker productivity. The finding strengthens the statements of Vietnamese construction practitioners and managers who believed that when aiming to improve CLP, AM is a determinant factor that managers should pay more attention to in addition to the conventional view that focuses on CM. Specifically, in the Vietnamese construction context, workers may perceive the importance of personal goals or the value of their work. In other words, they put effort into tasks because they may feel their job is important and enjoy finding valuable solutions to enhance their abilities or they feel there are many benefits in doing so. They may also acquire a sense of having an opportunity to learn new things or new skills when they participate in tasks. Consequently, they tend to put effort into pursuing their own goals to grow as a professional and to reach new highs.

As anticipated, the WE of the workers was directly and strongly related to their

autonomous motivation. As indicated in Table 4.5, AM (H9; β = 0.364, $p < 0.001$) positively and significantly predicted WE. Table 4.5 shows that these findings accord with [164], which indicated positive associations between two kinds of AM (e.g., intrinsic motivation and identified regulation) and the WE of Dutch employees. Likewise, AM has positive effects on teacher engagement [62] and employee engagement in service companies [150].

The authors of [76] mentioned the role of AM in CLP improvement, but they did not explain how AM could be generated and maintained. Hence, it is vital to tackle this issue. In this study, the author found that CS and RS positively and significantly predicted AM (H4a: β = 0.403, $p < 0.001$ and H5a: β = 0.33, $p < 0.001$, respectively) (Table 4.5). This revealed that satisfaction with competence and relatedness played a key role in promoting the AM of workers. As can be seen in Table 4.5, these findings were mostly consistent with those derived by [146], who reported that in the Singaporean academic context, CS (β = 0.4, $p < 0.05$) and RS (β = 0.6, $p < 0.01$) positively predict AM. Another study on the link between BPNs and motivation in the education context [57] indicated that both CS (β = 0.228, $p < 0.01$) and RS (β = 0.192, $p < 0.01$) had a positive and significant influence on intrinsic motivation (which is the highest type of AM in terms of autonomy level in SDT) for academic engagement among students.

To enhance CLP, it is necessary to explore new determinants that affect this aspect. In this study, the author found that CS and RS positively and significantly predicted CLP (H2b: β = 0.241, $p = 0.023 < 0.05$; H2c: β = 0.214, $p = 0.005 < 0.01$, respectively) (Table 4.5). These results are in line with the findings of [122], who found that CS directly predicted (β = 0.18, $p < 0.01$) the task performance of employees from a Canadian technology design and manufacturing company. The findings of [124] also revealed that CS directly contributed (β = 0.4, $p < 0.001$) to job

performance in a sample of teachers from Quebec, and the findings of [116] determined that RS was significantly related to work performance among employees in a financial company ($\beta = 0.12$, $p < 0.01$). Enhanced CS increases workers' confidence in undertaking and achieving desirable outcomes, thereby enhancing their productivity. Enhanced RS makes workers feel that they belong to and are part of a larger collective entity with valuable interpersonal relationships, thus promoting collaboration/support among team members onsite and directly contributing to productivity improvement.

The analysis of the roles of AM and CM in the current survey showed an interesting result: although both AM (e.g., work value) and CM (e.g., salary and reward) had significant effects on CLP, AM ($\beta = 0.268$) contributed to CLP more significantly or at least as significantly as CM ($\beta = 0.237$). This phenomenon can be explained by several factors. First, in the Vietnamese construction context, both practitioners and managers have emphasized the significant role of AM [32, 33]. The empirical evidence reinforces this viewpoint. The second factor is the high annual average income of the surveyed workers (i.e., 3811 USD per year) (Table 5.3). This income is considerably higher than the annual average income of Vietnamese citizens, who earned approximately 2700 USD in 2019 [171]. This finding implies that a high income can help Vietnamese workers to ensure good living standards. The author can also relate this to Maslow's hierarchy of needs theory [172], which is underlain by the progression principle: people's low-order needs (e.g., food, rest, and safety) must be satisfied before their high-order needs (e.g., self-worth, accomplishment, respect, self-fulfillment, seeking personal growth, and peak experiences). Another view maintains that this progression principle is not rigid but may be flexible depending on external circumstances or individual differences. Most behaviors are multi-motivated: "Any behavior tends to be determined by several or all of the basic needs

simultaneously rather than by only one of them" ([173], *p*.71). These reasons could have driven the higher or at least equal impact of AM on CLP in comparison with that of CM.

This feature consisted of the following components: (1) CS, RS → CLP (H2b,c); (2) CS, RS → AM, (H4a, H5a); (3) AM → CLP (H6); and (4) AM → WE (H9). As summarized in Table 5.5, items 1, 2, and 4 have never been studied or identified in the context of construction. Here, two observations were made. First, AM increased CLP and WE. The significance of AM provides a new perspective on research and practice with respect to how CLP and WE can be enhanced. Second, CS and RS play an important role in enhancing AM as well as CLP. This finding provides construction managers with a useful direction to pursue in labor management. Put differently, this finding affords construction practitioners a "new light of hope" with respect to CLP improvement.

4.5.3. Third Feature: The "Negative Legacy" of the Construction Industry

The discussion of this feature can start from the description of the first three hypotheses (H1a, H1b, and H1c) in the final structural model, which indicated that EL positively affected the three BPNs. With $\beta = 0.374$ ($p < 0.001$), EL positively and significantly influenced AS (H1a) but did not significantly contribute to CS (H1b) and RS (H1c) (Table 4.5). In the final structural model, eight items were chosen to calculate the EL variable: two items on strengthening (mean = 3.381, SD = 0.724), two on connection (mean = 3.387, SD = 0.659), and four on empowerment (mean = 3.400, SD = 0.704). These findings showed that construction managers more effectively contributed to workers' AS than their CS and RS.

The succeeding results necessitate a reconsideration of the meaning of AS. The ages and experiences of the workers were significantly correlated only with AS (Table

3), which did not significantly contribute to worker productivity (no support for H2a). Moreover, AS did not significantly contribute to the AM or CM of the workers (no support for H3a and H3b). These findings suggested that, among the surveyed respondents, the older and more experienced workers had a stronger sense of choice and freedom to do their tasks on the construction sites, but in a manner different from the assumption pursued in this work. The older and more experienced, but not necessarily skillful, workers perceived the satisfaction of autonomy as achieved through selfish work, which did not enhance the productivity and AM of the workers. Accordingly, selfish work as a novel factor negatively contributes to CLP, which is the first factor explored in the construction domain. Regarding the interpretation of AS as equivalent to working selfishly, some researchers emphasized that the difference in autonomy connotations in AM and autonomy satisfaction should be carefully considered. That is, the autonomy connotation in AS represents individuals' inherent desire to feel volitional and experience a sense of choice and psychological freedom when carrying out an activity [44], whereas the autonomy connotation in AM represents the performance of a task because it is enjoyable, optimally challenging, or self-endorsed [36].

To summarize these results, EL among the surveyed construction workers efficiently cultivated AS, but in a direction different from what the author assumed. Many practitioners, including supervisors/site engineers and workers, may misunderstand the meaning of AS, which appears to constitute the "negative legacy" of the construction industry.

In other domains, such as healthcare, the authors of [117] found that EL positively and significantly affected AS, which was consistent with the findings (Table 5.5). Furthermore, the authors of [42] elucidated the positive relationships between EL and three BPN of employees in engineering organizations. Their findings

are partially consistent with the findings of this study, wherein EL positively and significantly influenced AS only. These differences may be explained by the above analysis.

4.5.4. Fourth Feature: Work Engagement and Worker Productivity

The author expected WE to positively predict CLP (H12) for the following reasons. As illustrated by [174], there are four reasons why work-engaged employees outperform their non-work-engaged counterparts. First, work-engaged employees are more likely to experience positive emotions at work, such as joy or enthusiasm, which may explain why they are more productive. Second, work-engaged employees have more physical resources and are thus healthier, which means they can work more effectively by devoting their resources, energy, and skills to their jobs. Third, work-engaged employees are more productive because they can generate and mobilize their own resources. Fourth, employees who are engaged in work transfer or transmit their engagement to their co-workers. As a result, one employee's engagement is transferrable to another, resulting in improved team performance. However, the analysis demonstrated that the former did not significantly contribute to the latter ($\beta = 0.069$, $p = 0.195 > 0.05$). From a statistical perspective, this result could have been caused by the higher effects of the other variables (e.g., CS, RS, AM, and CM) on the dependent variable (CLP). Table 4.2 shows that the coefficients of correlation between CLP and the other variables, such as CS ($r = 0.480$), RS ($r = 0.422$), AM ($r = 0.502$), and CM ($r = 0.441$), were higher than the coefficient of correlation between CLP and WE ($r = 0.394$).

4.5.5. Labor Management Implications

To improve workforce management effectiveness and efficiency and labor productivity, construction managers should pay more attention to enhancing the AM of their employees in the workplace in addition to enhancing CM according to the conventional view. Based on the results of this study, to generate and maintain AM at work, construction managers should make their employees feel satisfied with their competence and relatedness. Theoretically, CS and RS can be promoted by introducing a reasonable leadership style. To do so, in this study, the author introduced a new leadership concept in the construction domain - EL. Based on the analysis, unfortunately, this study could not determine this leadership style directed toward how to satisfy and enhance CS and RS. However, based on observed items measuring the variables in this study, we proposed several tentative recommendations to promote AM as well as improve CLP as follows: to make employees feel confident and effective when performing their tasks onsite, construction managers should encourage them to develop practical skills and accumulate valuable experience as well as use their strengths as much as possible in the task; in addition, promoting collaboration/support and close connection among team members should be paid more attention by construction managers. Moreover, providing a better work environment with a comfortable atmosphere can make workers feel that they truly belong to a crew and feel satisfied with their valuable relationships at work.

4.6. Conclusions

This study explored the significant role of AM in CLP improvement and how AM can be generated and maintained by developing a novel model for assessing the effects of EL, three basic psychological satisfaction factors, and work motivation on CLP according to SDT. Relying on data collected from 215 workers in Vietnam, the

author performed SEM to assess the hypothesized structural model. The validity and reliability of the scales, convergent validity, and the model's GoF were tested through reasonable techniques, such as Cronbach's alpha analysis, EFA, and CFA.

In addition to reinforcing the traditional view, which emphasized the role of CM in CLP improvement, this study reveals several interesting findings. First, the important role of AM in proving CLP was explored. Second, to improve AM and CLP, satisfaction of competence and relatedness needs played a vital role. These findings provide a new perspective on both industry and academics with respect to how CLP can be enhanced, as well as how AM can be generated and maintained. Finally, the "negative legacy" of the construction industry was explored. This feature implied that the older and more experienced, but not necessarily skillful, workers perceived AS as being achieved through selfish work, resulting in an obstacle to productivity improvement and the promotion or maintenance of work motivation. Selfish work is a novel factor that negatively contributes to CLP.

Chapter 5. Measuring Work Autonomy and Its Role in Enhancing Construction Labor Productivity

5.1. Introduction

In Chapter 4, the author identified four features with respect to improving CLP. Among these four features, “new light of hope” (i.e., the important role of AM in improving CLP) brings a new direction for effective and efficient labor management which improves CLP, whereas “negative legacy” decreases CLP. The question lingers on how can “new light of hope” increase? and how can “negative legacy” decrease? To address this question, the author studies work autonomy (by integrating types of work motivation) because studying this aspect promisingly solves the above-mentioned question and brings several benefits for both theoretical and practical labor management with respect to improving CLP.

Autonomy at work favourably influences an individual’s work performance [175, 176], creativity [177] and well-being [178]. Work autonomy (WA) is neither about passively enabling employees to be independent nor allowing work in isolation or work without guidance, boundaries, supervision or collaboration. Such freedom revolves around clearing the way for employees to work in a manner that is most conducive to excellent performance. Promoting autonomy at work means empowering employees to exercise self-control, granting them stewardship over their work and environment and providing them with support instead of exerting control over them [179]. Autonomy at work can also help employees feel valued and accountable for the tasks that they oversee, and when they feel trusted, they are likely to perform exceptional work. Therefore, increasing autonomy in the workplace generates win–win outcomes that benefit both employers and employees [35].

Despite significant technological advancements, construction remains a labour-

intensive industry [19]. Thus, the enhancement of construction labour productivity (CLP) can markedly advance project effectiveness [18] and generate substantial cost savings for construction organisations [20]. Onsite, a worker is part of a construction crew and executes many tasks that range from very easy to difficult and require physical labour. Some of these activities are dangerous and hazardous. Therefore, improving CLP in a sound manner necessitates understanding how many onsite workers experience WA, why some workers experience such freedom while others do not, what kind of WA they enjoy, how it influences CLP and what measures should be taken. Notwithstanding the importance of such issues, however, limited studies have been devoted to WA in the construction industry.

The first steps in exploring WA among onsite construction workers are determining how their WA levels can be measured and implementing this measurement. One such method for quantitatively assessing autonomy at work is a powerful general indicator called the relative autonomy index (RAI), which has been continually developed [84-86]. Its adjusted modifications have become the most widely used measure of autonomy in behavioural research [84-86]. The RAI is a suitable tool for measuring WA among onsite workers, including those working in the context of Vietnam, where construction managers believe that empowerment is key to enhanced work performance and some are willing to grant increased authority to workers provided that they generate desirable outcomes [32, 33]. Nevertheless, because WA in the construction industry has been minimally investigated, this concept may not be sufficiently understood or shared by many construction practitioners. This case gives rise to the possibility that indices other than the RAI are more appropriate for characterising WA among onsite construction workers and explaining its contribution to CLP. This assertion is supported by the fact that although WA has been found important in enhancing work performance [175, 176], a

study in the construction domain found both the autonomous and controlled motivation of onsite Vietnamese workers as positive and significant contributors to CLP enhancement [38]. Accordingly, the second step in exploring WA among onsite workers is to examine the influence of this freedom on CLP.

The third step in the above-mentioned exploration is to identify how WA can be cultivated. The ways by which WA can be fostered and maintained can be explained on the basis of self-determination theory (SDT), specifically through the satisfaction of three basic psychological needs: autonomy, competence and relatedness. SDT also clarifies the degree to which the motivation to engage in activities is deemed internal (i.e., the degree of self-involvement) and how varying levels of this self-determination influence the selection of actions that generate desired outcomes [44].

The fourth step is to identify and discuss policy implications on the basis of the results acquired in the previous three steps. In this research, the author focused on the WA and CLP associated with simple tasks that do not require outstanding skills. Most onsite workers begin their practice implementing straightforward responsibilities, such as rebar and masonry tasks, which account for the majority of construction quantity and cost for multi-storey residential projects in Vietnam. By focusing on these tasks, the author could characterise each group of workers on the basis of certain attributes, such as length of experience and gender. A clear characterisation of each worker group shed light on the advantages and disadvantages of current labour management and policy in Vietnam.

The last step in exploring the WA of onsite construction workers is to ascertain what the optimality of WA scoring protocols means - an issue that has yet to be resolved [87]. The author argue that optimality should be considered on the grounds of each step discussed above, that is, taking into account the effectiveness of index-driven characterisation, its contribution to CLP improvement, a clear identification of

influencing factors for WA and the persuasiveness of policy recommendations.

5.2. Research Objectives

To achieve the goal of this study, the author sought to enhance existing knowledge of WA in the construction industry by pursuing the following objectives:

- To determine how the WA of onsite construction workers can be ascertained and to quantitatively measure this construct;
- To analyse the contribution of WA to CLP improvement;
- To identify how WA can be cultivated and maintained through the satisfaction of the three basic psychological needs;
- To derive and discuss policy recommendations for improving CLP;
- To cast light on the meaning of optimality in WA scoring protocols.

5.3. Research Hypotheses Development

5.3.1. The relationship between work autonomy and construction labour productivity

Previous studies emphasised the important role of WA in enhancing work performance [175, 176, 179] and demonstrated a consistent and positive relationship between these variables. For instance, researchers asserted that high autonomy improves employees' work performance because under such conditions, they perceive themselves as capably and resourcefully performing a task [180]. Other scholars described individuals with high autonomy as feeling responsibility for their work outcomes given that their personal initiative-related judgment of how to carry out tasks can directly influence such outcomes [181]. These insights are considered applicable to the construction sector despite the absence of quantitative studies on the relationship between WA and work performance in this industry. Some construction

practitioners have emphasised the significant role of autonomy at work in labour productivity improvement [32, 33]. More specifically, as derived in Chapter 4, autonomous motivation (which, in SDT, refers to high autonomy) significantly and positively contributes to worker productivity [38]. In line with these arguments, therefore, the author examines the relationship between WA and CLP on the grounds of the following supposition:

Hypothesis 1 (H1). WA is associated with onsite worker productivity (represented by CLP).

5.3.2. The relationship between the satisfaction of three basic psychological needs and work autonomy

A necessary task is to explore the ways by which WA can be cultivated and maintained, and this objective can be accomplished by adopting a suitable motivational theory. In this regard, basic psychological need theory, one of the six constituent perspectives under SDT [37, 44, 114], is a promising lens through which to elaborate on how psychological satisfaction can promote individuals' autonomy to engage in an activity or task. Basic psychological need theory describes human beings as having three basic psychological needs, namely, autonomy satisfaction, competence satisfaction and relatedness satisfaction [36, 37]. The need for autonomy is satisfied when one experiences a sense of volition, psychological freedom and authorship in one's thinking, acting and feeling [44, 45]. SDT's notion of autonomy also encompasses the absence of pressure and conflict [46, 47]. The need to feel competent is satisfied when a sense of mastery and efficacy in one's activities is perceived. One feels that one is capable of what one does and is able to accomplish projects and achieve one's goals [44, 48]. Finally, the need for relatedness is satisfied when people experience a sense of communion and develop close and intimate

relationships with others [44]. Relatedness pertains to the intrinsic yearning of individuals to feel connected to others, that is, to be a member of a group, to love and care and to be loved and cared for [49].

In the SDT framework, the satisfaction of basic psychological needs (i.e., autonomy, competence and relatedness) is assumed to represent the underlying motivational mechanism that energises and directs people's behaviours [44]. Such satisfaction is regarded as the essential component in individuals' optimal functioning and well-being, similar to how water, minerals and sunshine are critical for plants to bloom [44, 52]. SDT postulates the existence of psychological satisfaction as important in individual motivation, growth and performance [36, 37]. The relationships between basic psychological need satisfaction (BPNS) and work motivation are consistent [52], and WA can be measured on the basis of different types of motivation falling within the self-determination continuum. To date, however, no study has examined the link between the three basic psychological needs and WA.

The author, therefore, confirmed whether such a relationship exists and accordingly hypothesised favourable relationships between the three basic psychological needs and the WA of onsite construction workers. To begin with, psychological satisfaction contributes to autonomy at work because, as demonstrated in [144, 145], the satisfaction of autonomy, competence and relatedness needs facilitates intrinsic motivation, which corresponds to the highest autonomy in SDT. In addition, as derive in Chapter 4, both competence satisfaction and relatedness satisfaction significantly and positively contribute to autonomous motivation, which also points to a high level of autonomy in SDT. When workers are empowered with authority, they are willing to participate at work because they feel an elevated sense of choice and freedom to do their designated tasks [32, 33]. When they are satisfied with their competence, they tend to voluntarily engage in activities intended to help

them prove themselves, especially challenging ones. When their need for relatedness is met through valuable interpersonal relationships with teammates, these connections generate positive emotions and increase cognitive processing. These effects naturally induce and foster proactive engagement with work, thereby preserving valuable ties, enhancing practical skills or encouraging the receipt of appreciative feedback from teammates. On the grounds of this discussion, the author formulates the following hypotheses:

Hypothesis 2 (H2). Autonomy satisfaction is associated with the WA of workers.

Hypothesis 3 (H3). Competence satisfaction is associated with the WA of workers.

Hypothesis 4 (H4). Relatedness satisfaction is associated with the WA of workers.

The research model of this study is presented in Figure 5.1.

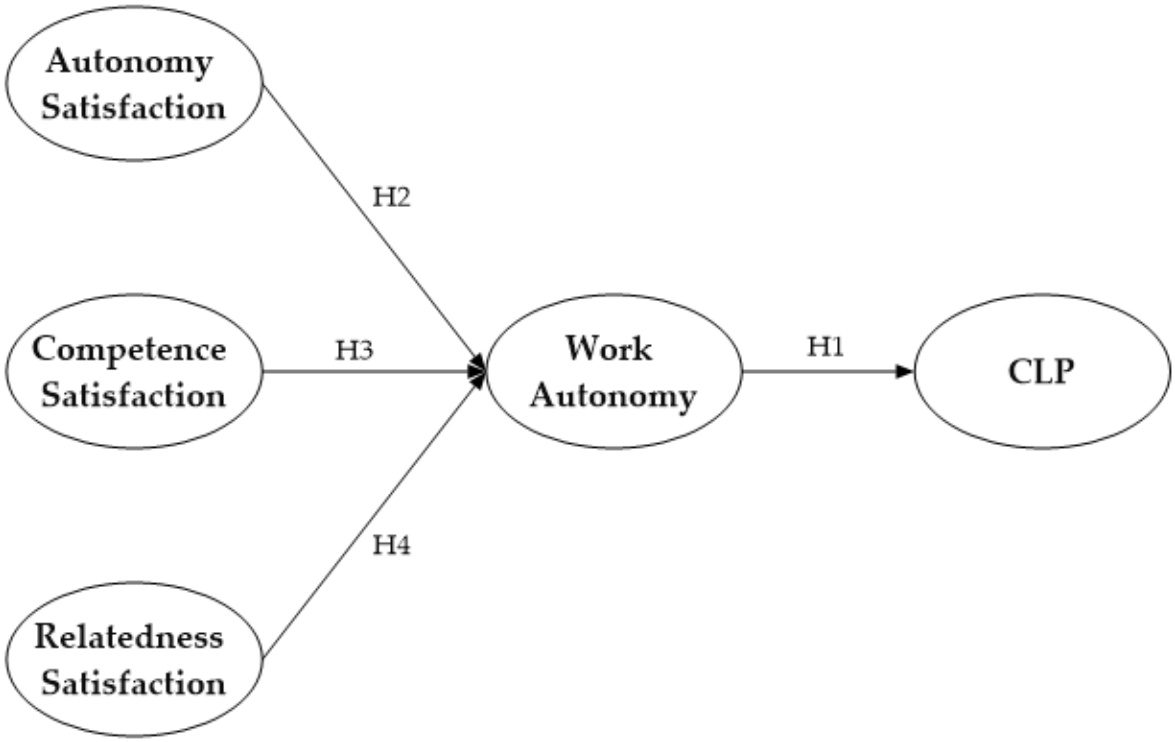

Figure 5.1. Research model of the study 2

5.4. Results

5.4.1. Factor Analysis and Reliability Test

Table 5.1 shows the items' factor loadings, derived via the EFA for which the principal axis method with Varimax rotation was adopted. Six components emerged in the consideration of the factor loadings of the final set of 19 motivational items. These six motivational subscales explained 70.597% of the variance, with eigenvalues exceeding 1. The KMO test generated a value of 0.736, and Bartlett's sphericity test derived a statistically significant result ($p < 0.001$). These values confirmed the acceptability of the factor analysis. The internal consistency of the scales was assessed using the following Cronbach's alpha values: introjected regulation = 0.855, intrinsic regulation = 0.841, external regulation = 0.806, amotivation = 0.774, integrated regulation = 0.742 and identified regulation = 0.638. These values exceed 0.6, pointing to the reliability of the six motivational dimensions studied in this work. The scores of the 19 final items under the six motivational subscales were used to calculate the RAI. Specifically, the latent factors were extracted as follows: amotivation on the basis of Amot1, Amot3 and Amot4; external regulation on the basis of Exter2, Exter7, Exter8 and Exter9; introjected regulation using Intro1, Intro2, Intro4 and Intro6; identified regulation on the grounds of Iden2 and Iden5; integrated regulation on the basis of Inte2 and Inte5; and intrinsic regulation using Intri1, Intri4, Intri5 and Intri6.

Table 5.1. Exploratory factor analysis and reliability of motivational subscales

Variable	Component					
	Intro	Intri	Exter	Amot	Inte	Iden
Intro6	0.936					
Intro2	0.936					
Intro1	0.738					
Intro4	0.675					
Intri6		0.836				
Intri1		0.804				
Intri4		0.791				
Intri5		0.752				
Exter2			0.819			
Exter8			0.778			
Exter7			0.770			
Exter9			0.678			
Amot3				0.878		
Amot4				0.838		
Amot1				0.762		
Inte5					0.880	
Inte2					0.874	
Iden2						0.814
Iden5						0.741
Initial eigenvalues	4.57	2.65	2.11	1.51	1.48	1.10
% of variance	24.07	13.93	11.13	7.93	7.77	5.77
Cumulative %	24.07	37.99	49.12	57.05	64.82	70.59
Cronbach's alpha	0.855	0.841	0.806	0.774	0.742	0.638
Mean	3.50	3.38	3.62	1.82	3.51	3.42
Standard deviation	0.825	1.03	0.870	0.367	0.875	0.970
Kaiser–Meyer–Olkin measure of sampling adequacy	0.736					
Bartlett's test of sphericity						
Approx. chi-square	2544.42					
df	171					
Sig.	0.000					

Note: All factor loadings below 0.50 were excluded.

As demonstrated in Table 5.1, among the six motivational subscales, external regulation was the latent variable for which the participants had the highest score, with a mean (standard deviation (SD)) of 3.62 (0.870). The next highest scores

obtained were those on integrated regulation (mean (SD) = 3.51 (0.875)), introjected regulation (mean (SD) = 3.50 (0.825)), identified regulation (mean (SD) = 3.42 (0.970)) and intrinsic regulation (mean (SD) = 3.38 (1.03)). The participants obtained the lowest score on amotivation, with its mean (SD) being 1.82 (0.367). Accordingly, WA was determined using the scoring protocols based on these motivational subscales.

5.4.2. New Index and Evaluation of Work Autonomy among Onsite Workers

This section details the proposed index for measuring the autonomy of onsite construction workers.

5.4.2.1. Aggregated Motivation Index

[86] raised the important issue of how best to combine the scores obtained using various motivational subscales into one score. To derive the optimum scoring protocol for measuring autonomy at work, the author developed an alternative to the RAI on the basis of the results and the following factors:

The first and main factor is the applicability of the simplex concept in Guttman's Radex theory [182] on the ordered relations of correlated variables. Here, the magnitude of correlations among variables reflects their conceptual similarities. Variables are more similar when they are more highly correlated and vice versa. Specifically, a perfect simplex model evidences its largest correlations along a main diagonal, and these correlations increasingly taper off as one moves away from the diagonal. The results of matrices of correlation between motivational subscales for different work experiences are shown in Tables 5.2-5.4. These matrices are not considered close to the simplex matrix. The coefficients of correlation between external regulation and intrinsic regulation, as well as those between introjected

regulation and intrinsic regulation, were generally high. This means that external, introjected and intrinsic types of regulation were perceived similarly by the workers. More specifically, the correlations imply that the continuum of autonomy advocated in SDT may not hold.

Table 5.2. Correlations among the five motivational subscales for the group with <5 years of experience

	Exter	Intro	Iden	Inte	Intri
Exter	1	0.229 *	0.111	0.164	0.236 *
Intro	0.229 *	1	0.115	0.151	0.204 *
Iden	0.111	0.115	1	0.130	0.259 *
Inte	0.164	0.151	0.130	1	0.140
Intri	0.236 *	0.204 *	0.259 *	0.140	1

Note: * $p < 0.05$

Table 5.3. Correlations among the five motivational subscales for the group with 5–10 years of experience

	Exter	Intro	Iden	Inte	Intri
Exter	1	0.206	0.098	0.105	0.516 **
Intro	0.206	1	−0.033	0.236 *	0.129
Iden	0.098	−0.033	1	0.007	−0.043
Inte	0.105	0.236 *	0.007	1	0.097
Intri	0.516 **	0.129	−0.043	0.097	1

Note: * $p < 0.05$, ** $p < 0.01$.

Table 5.4. Correlations among the five motivational subscales for the group with >10 years of experience.

	Exter	Intro	Iden	Inte	Intri
Exter	1	0.430 **	0.244	–0.050	0.573 **
Intro	0.430 **	1	0.483 **	0.056	0.438 **
Iden	0.244	0.483 **	1	–0.084	0.305
Inte	–0.050	0.056	–0.084	1	0.026
Intri	0.573 **	0.438 **	0.305	0.026	1

Note: ** $p < 0.01$.

The second factor is related to empirical evidence from [38], which indicated that both autonomous and controlled kinds of motivation positively and significantly

contribute to work engagement and productivity among onsite construction workers. The study suggested that controlled motivation advances the perception of autonomy at surveyed sites. This result is consolidated with the first factor discussed above.

The third factor was discussed in [87], wherein the researchers asserted that the item-aggregation approach (i.e., averaging items constituting each individual BREQ subscale, including external, introjected, identified and intrinsic regulation) is the most informative scoring protocol. This suggests that an approach to measuring autonomy via the aggregation of motivational subscales is suitable. Correspondingly, worthwhile tasks are to put forward similar weights associated with these subscales and confirm their validity.

In the SDT framework, autonomous motivation (i.e., identified, integrated and intrinsic regulation) positively contributes to connotations about autonomy, whereas controlled motivation (i.e., external and introjected regulation) negatively contributes to such perceptions. With the above-mentioned reasons as anchor, the author developed the aggregated motivation index (AMI) as an alternative measurement of autonomy at work. In the AMI, the scores derived with respect to the two types of controlled motivation and the three types of autonomous motivation are averaged. In other words, the AMI reflects the mean values of five motivational subscales—external, introjected, identified, integrated and intrinsic regulation. Given that amotivation does not contribute to autonomy, it is reasonable to exclude it from the AMI.

As previously stated, few studies have acquired empirical evidence of how the autonomy of construction practitioners can be measured. The current work was therefore conducted to quantitatively measure the WA levels of construction workers using a conventional RAI formula and the proposed AMI. The traditional RAI formula used in [86] was also employed in the present research because it enables a

full evaluation of all possible scoring indicators available within the SDT framework.

5.4.2.2. Quantitatively Measuring Onsite Workers' Autonomy

This section recounts the quantitative measurement of autonomy among workers, as well as the exploration into the differential effects of the RAI formula and AMI scoring protocol. Table 5.5 shows the results of the RAI and AMI measurements performed on the basis of various demographic characteristics. The comparison of these measures enabled us to characterise each group of workers and what motivations drive them. This characterisation, in turn, paved the way for discussions of work autonomy from different viewpoints. A low RAI score indicates increased amotivation or controlled motivation, whereas a high RAI score reflects increased autonomous motivation [85]. A high AMI score generally reflects considerable controlled and autonomous motivation, whereas a low score points to the opposite.

Table 5.5. Measuring the autonomy of workers onsite

	Category	N	RAI			AMI		
			Mean	SD	ANOVA (sig.)	Mean	SD	ANOVA (sig.)
Gender	Male	187	4.64	3.67	0.009	3.50	0.546	0.588
	Female	28	2.66	4.09		3.44	0.528	
Educational level	Primary school and below	65	4.01	4.00	0.636	3.52	0.515	0.892
	Secondary school	94	4.52	3.59		3.48	0.610	
	High school and above	56	4.58	3.85		3.47	0.456	
Age	<=35 years old	162	4.19	3.81	0.196	3.50	0.544	0.582
	>35 years old	53	4.96	3.62		3.45	0.543	
Work experience	<5 years	94	4.57	3.95	0.283	3.56	0.515	0.004
	5–10 years	84	3.90	3.55		3.52	0.497	
	>10 years	37	4.99	3.78		3.22	0.638	
Marital status	Single	50	4.49	3.73	0.821	3.43	0.603	0.426
	Married	165	4.35	3.80		3.50	0.525	
Income	Low income	95	4.40	3.83	0.957	3.53	0.397	0.310
	High income	120	4.37	3.75		3.45	0.635	
Training	Untrained	182	4.31	3.88	0.524	3.50	0.556	0.533
	Trained	33	4.77	3.12		3.43	0.472	

A one-way analysis of variance (ANOVA) [183] was conducted to delve into whether the RAI/AMI mean scores under various categories exhibit statistically significant differences. The results are shown in Table 5.5. There are three noteworthy characteristics. First, workers of different genders exhibited significantly different RAI scores. Second, the mean RAI of workers with more than 10 years of experience was the highest, but their mean AMI was the lowest. Workers with various work experiences exhibited significant differences in AMI scores. Third, no significant

difference was found with respect to the other demographic variables of interest.

5.4.3. Influence of Work Autonomy on CLP Improvement and Its Relationship with BPNS

This section presents the analysis of the influence of WA on improving CLP and its association with BPNS.

5.4.3.1. Development of Structural Equation Modelling

For this examination, the author adopted an approach similar to the EFA involving the motivational subscales. Table 5.6 shows the factor loadings of the EFA-based items; these loadings were determined using the principal axis method. Four components emerged from the factor loadings of the final set of 13 BPNS items and three CLP items. These components explained 73.708% of the variance, with eigenvalues exceeding 1. The KMO test generated a value of 0.836, and Bartlett's sphericity test derived a statistically significant result ($p < 0.001$). These values confirmed the acceptability of the factor analysis.

The latent factors were extracted as follows (Table 5.6): Autonomy satisfaction was extracted using AS4, AS2, AS1, AS3 and AS5; competence satisfaction was extracted on the basis of CS5, CS4, CS6 and CS2; relatedness satisfaction was extracted using RS1, RS3, RS5 and RS6; and CLP was extracted on the grounds of LP3, LP1 and LP5. Among all three BPNS subscales, competence satisfaction was the latent variable for which the participants gained the highest score, with its mean (SD) being 3.49 (0.809). The next highest scores were those on autonomy satisfaction (mean (SD) = 3.47 (0.855)) and relatedness satisfaction (mean (SD) = 3.35 (0.997)).

The author analysed the internal consistency of the scales with the Cronbach's alpha values as bases. These values are as follows: autonomy satisfaction = 0.962,

competence satisfaction = 0.804, relatedness satisfaction = 0.813 and CLP = 0.844 (Table 4.6). These exceed 0.6, pointing to the reliability of the study. These latent variables were calculated on the basis of their indications for further analyses.

Table 5.6. Exploratory factor analysis and reliability

Variable	**Component**			
	AS	**CS**	**RS**	**CLP**
AS4	0.932			
AS2	0.931			
AS1	0.917			
AS3	0.910			
AS5	0.884			
CS5		0.821		
CS4		0.730		
CS6		0.689		
CS2		0.588		
RS1			0.784	
RS3			0.732	
RS5			0.700	
RS6			0.657	
LP3				0.873
LP1				0.775
LP5				0.748
Initial eigenvalues	4.69	4.30	1.54	1.25
% of variance	29.34	26.89	9.63	7.84
Cumulative %	29.34	56.23	65.86	73.70
Cronbach's alpha	0.962	0.804	0.813	0.844
Mean	3.47	3.49	3.35	3.42
SD	0.855	0.809	0.997	0.970
Kaiser–Meyer–Olkin measure of sampling adequacy	0.836			
Bartlett's test of sphericity				
Approx. chi-square	2314.159			
df	120.000			
Sig.	0.000			
Composite reliability (CR)	0.957	0.806	0.814	0.846
Average variance extracted (AVE)	0.818	0.511	0.522	0.648
Note: All factor loadings below 0.50 were excluded.				

As shown in Table 5.6, the CR values of autonomy satisfaction, competence satisfaction, relatedness satisfaction and CLP were 0.957, 0.806, 0.814 and 0.846, respectively. These are greater than the measurement model's threshold of 0.7, indicating the acceptable consistency and reliability of the model. The AVE values were 0.818, 0.511, 0.523 and 0.648, respectively, pointing to a high degree of convergent validity, seeing as they all exceed 0.5 [99].

SEM was adopted to analyse the influence of WA on CLP improvement and the effects of BPNS on WA. The final structural model acceptably fit the data and, overall, performed better than the initial model, as evidenced by the following values: $\chi 2/df$ = 1.818, CFI = 0.961, TLI = 0.952, GFI = 0.900, NFI = 0.917, AIC = 287.19 and RMSEA = 0.062 (Table 5.7). These results demonstrated that all the fit indices satisfied the criteria; thus, the values of the final fit indices in the final structural model suggested the interpretability of the improved model. These findings also confirmed the validity and reliability of the measurement model.

Table 5.7. Goodness-of-fit results

Indicator	**Recommended Level**	**Initial Model**	**Final Model**
χ^2/df	from 1 to 2 [100]	2.279	1.818
CFI	0 (no fit) to 1 (perfect fit) [92, 98]	0.877	0.961
TLI	0 (no fit) to 1 (perfect fit) [92, 98]	0.863	0.952
GFI	0 (no fit) to 1 (perfect fit) [92, 98]	0.824	0.900
NFI	0 (no fit) to 1 (perfect fit) [92, 98]	0.802	0.917
AIC	Smaller value [101]	615.23	287.19
RMSEA	<0.05, very good fit; 0.05–0.08, fairly good fit; 0.08–0.10, acceptable fit; >0.1, unacceptable fit [102]	0.077	0.062

5.4.3.2. Quantitative analyses of the influence of WA on CLP and the influence of BPNS on WA

The author conducted quantitative analyses of the influence of WA on CLP and the influence of BPNS on WA. Table 5.8 lists the mean values and standard deviations of the CLP of workers with different work experiences. CLP decreased with increasing experience.

Table 5.8. Mean and standard deviation of CLP among workers with different work experiences

	All	Work Experience		
		<5 Years	5–10 Years	>10 Years
Mean	3.42	3.55	3.38	3.18
SD	0.970	0.871	1.02	1.05

Table 5.9.a&b show the results of the regression analyses associated with the four hypotheses. As reflected in the tables, both the AMI and RAI were used to measure WA. The regression coefficients derived using the AMI were statistically significant at $p = 0.001$ for H1, H3 and H4, and those obtained using the RAI were statistically significant at $p = 0.005$ for H1 and H4.

Table 5.9. (a) Results of regression analyses associated with the four hypotheses (for AMI). (b) Results of regression analyses associated with the four hypotheses (for RAI).

H	Path	All		Work Experience					
				<5 years		5–10 years		>10 years	
		β	*p*	β	*p*	β	*p*	β	*p*
(a) for AMI represented WA									
H1	WA → CLP	0.454	***	0.495	***	0.384	***	0.491	0.003
H2	Autonomy satisfaction (AS) → WA	−0.119	0.063	0.001	0.993	−0.123	0.211	−0.397	0.006
H3	Competence satisfaction (CS) → WA	0.287	***	0.338	0.003	0.215	0.046	0.373	0.013
H4	Relatedness satisfaction (RS) → WA	0.352	***	0.183	0.074	0.455	***	0.301	0.082
(b) for RAI represented WA									
H1	WA → CLP	0.203	0.005	0.257	0.018	0.153	0.196	0.239	0.166
H2	Autonomy satisfaction (AS) → WA	−0.124	0.066	−0.090	0.393	−0.127	0.202	−0.221	0.161
H3	Competence satisfaction (CS) → WA	−0.023	0.751	0.099	0.388	−0.128	0.226	0.143	0.397
H4	Relatedness satisfaction (RS) → WA	0.247	0.001	0.108	0.307	0.453	***	−0.078	0.671

Note: *** $p < 0.001$.

Table 5.10. Means and standard deviations of basic psychological needs and motivational subscales.

Category			BPNS			Amot	Controlled		Autonomous		
			AS	CS	RS		Exter	Intro	Iden	Inte	Intri
Gender	Male	Mean	3.47	3.50	3.36	1.81	3.61	3.49	3.42	3.52	3.44
		SD	0.86	0.81	1.01	0.38	0.87	0.85	0.98	0.87	1.02
	Female	Mean	3.43	3.43	3.26	1.94	3.73	3.52	3.43	3.46	3.04
		SD	0.84	0.84	0.95	0.18	0.91	0.60	0.89	0.93	1.08
Work experience	<5 years	Mean	3.37	3.51	3.49	1.87	3.72	3.53	3.47	3.60	3.49
		SD	0.85	0.79	0.93	0.37	0.72	0.84	1.00	0.81	1.03
	5–10 years	Mean	3.51	3.51	3.26	1.85	3.71	3.60	3.47	3.49	3.34
		SD	0.91	0.77	1.09	0.33	0.92	0.70	0.85	0.94	1.04
	>10 years	Mean	3.62	3.40	3.20	1.67	3.18	3.18	3.19	3.32	3.23
		SD	0.70	0.94	0.94	0.42	0.98	0.99	1.13	0.88	1.03
Training	Untrained	Mean	3.39	3.49	3.34	1.86	3.64	3.51	3.43	3.51	3.40
		SD	0.85	0.80	1.02	0.35	0.87	0.85	0.93	0.89	1.04
	Trained	Mean	3.89	3.45	3.39	1.66	3.55	3.42	3.39	3.52	3.28
		SD	0.76	0.85	0.89	0.40	0.90	0.65	1.19	0.80	1.03
Total		Mean	3.47	3.49	3.35	1.82	3.62	3.50	3.42	3.51	3.38
		SD	0.86	0.81	1.00	0.37	0.87	0.82	0.97	0.87	1.03

Table 5.11. Selected items related to BPNS variables and motivational subscales of the work experience and gender groups

Observed item		Work experience						Gender				Total	
		<5 years		5–10 years		>10 years		Male		Female			
		Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
AS1	I feel that my decisions reflect what I really want.	3.40	.896	3.55	.949	3.62	.721	3.49	.906	3.57	.790	3.50	.891
AS2	I feel my choices express who I really am.	3.33	.988	3.52	.950	3.51	.768	3.45	.934	3.32	.983	3.44	.940
AS3	I feel I have been doing what really interests me.	3.43	.967	3.50	.951	3.70	.777	3.52	.918	3.36	1.026	3.50	.932
AS4	I feel a sense of choice in the tasks I undertake.	3.33	.932	3.52	.925	3.59	.762	3.44	.928	3.50	.745	3.45	.905
AS5	I feel freedom in the tasks I undertake.	3.34	.887	3.48	1.012	3.65	.753	3.45	.923	3.39	.916	3.45	.920
CS2	I feel I can successfully complete difficult or challenging tasks.	3.62	1.017	3.56	.949	3.35	1.160	3.57	.994	3.39	1.166	3.55	1.017
CS4	I feel confident that I can do things well.	3.53	1.104	3.51	.963	3.49	1.070	3.52	1.034	3.50	1.106	3.52	1.041
CS5	I feel effective in what I do onsite.	3.32	.941	3.44	1.010	3.22	1.031	3.36	.998	3.25	.887	3.35	.983
CS6	I feel I have sufficient work-related skills or knowledge onsite.	3.55	.990	3.51	1.024	3.54	1.192	3.53	1.044	3.57	.997	3.53	1.036
RS1	I feel close and connected with other	3.53	1.114	3.19	1.452	3.16	1.191	3.32	1.300	3.46	1.105	3.33	1.275

Observed item		Work experience						Gender				Total	
		<5 years		5–10 years		>10 years		Male		Female			
		Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
	people onsite (e.g. supervisor, teammates).												
RS3	I experience a happy feeling with the people I spend time with onsite.	3.34	1.063	3.19	1.285	2.97	1.142	3.26	1.159	2.96	1.232	3.22	1.170
RS5	I experience a comfortable feeling with the people I spend time with onsite.	3.57	1.092	3.36	1.295	3.41	1.404	3.49	1.220	3.29	1.301	3.46	1.229
RS6	My supervisors and teammates help me when I need help.	3.50	1.259	3.30	1.395	3.27	1.217	3.39	1.317	3.32	1.249	3.38	1.305
Why do you or would you put effort into your current job onsite?													
Amot1	I don't know why I am doing this job; it's pointless to work.	1.81	.396	1.86	.352	1.73	.450	1.79	.407	1.96	.189	1.81	.390
Amot3	I don't because I really feel that I'm wasting my time at work.	1.82	.486	1.81	.452	1.57	.502	1.75	.501	1.89	.315	1.77	.483
Amot4	But I do not have a good reason for work.	1.97	.451	1.88	.422	1.70	.463	1.88	.465	1.96	.331	1.89	.450
Exter2	Because others will respect me more (e.g. supervisor, teammates).	3.77	1.052	3.77	1.112	3.46	1.120	3.68	1.099	3.96	.999	3.72	1.089
Exter7	Because I will be rewarded financially	3.72	1.062	3.73	1.022	3.14	1.294	3.61	1.104	3.71	1.150	3.62	1.108

Observed item		Work experience						Gender				Total	
		<5 years		5–10 years		>10 years		Male		Female			
		Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
	only if I put enough try into my job.												
Exter8	Because I work at safety and health conditions.	3.67	.977	3.57	1.235	3.08	1.064	3.52	1.114	3.57	1.136	3.53	1.114
Exter9	Because I received good support from others in my work (e.g. supervisor, teammates).	3.73	.941	3.76	1.082	3.05	1.177	3.62	1.088	3.68	.945	3.63	1.068
Intro1	Because I have to prove to myself that I can.	3.41	1.231	3.60	1.253	3.00	1.453	3.42	1.306	3.39	1.197	3.41	1.290
Intro2	Because it makes me feel proud of myself.	3.37	1.236	3.69	1.130	3.27	1.347	3.50	1.237	3.36	1.129	3.48	1.222
Intro4	Because otherwise, I would feel ashamed of myself.	3.94	1.133	3.43	1.134	3.16	1.265	3.55	1.188	3.96	1.013	3.60	1.165
Intro6	Because otherwise, I would feel bad about myself.	3.38	1.245	3.69	1.130	3.27	1.347	3.50	1.242	3.36	1.129	3.48	1.226
Iden2	Because I try to improve my skills in my works.	3.61	.964	3.57	1.045	3.22	1.182	3.52	1.069	3.57	.836	3.53	1.040
Iden5	Because I receive appropriate feedback from my supervisors, teammates.	3.34	1.007	3.37	.903	3.16	.949	3.33	.941	3.29	1.036	3.32	.954

Observed item		Work experience						Gender				Total	
		<5 years		5–10 years		>10 years		Male		Female			
		Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Inte2	Because it is very meaningful for me.	3.51	1.024	3.65	1.000	3.27	1.170	3.53	1.054	3.46	.999	3.53	1.045
Inte5	Because putting try into this job aligns with my personal values.	3.69	.949	3.33	1.040	3.38	.962	3.50	.977	3.46	1.041	3.50	.984
Intri1	Because it is really important for me.	3.52	1.285	3.33	1.338	3.32	1.132	3.48	1.233	2.96	1.503	3.41	1.279
Intri4	Because I have a chance to learn new things/new skills.	3.46	1.276	3.37	1.210	3.08	1.211	3.38	1.236	3.21	1.287	3.36	1.241
Intri5	Because I would feel there are many benefits to do it.	3.33	1.081	3.20	1.259	3.11	1.100	3.28	1.159	2.96	1.105	3.24	1.155
Intri6	Because I enjoy finding valuable solutions from my teammates.	3.64	1.367	3.44	1.329	3.41	1.322	3.60	1.318	3.00	1.414	3.52	1.342

5.5. Discussions

On the basis of the results, the author identified several valuable features relevant to effective and sustainable construction workforce management.

5.5.1. First feature: Gender

The ANOVA results revealed significant differences in RAI mean scores (sig. = 0.009) between the genders, but no such variances in mean AMI values were found (Table 5.5). Specifically, as indicated by their RAI score of 2.66, the female onsite workers had lower autonomy in task completion than that enjoyed by their male counterparts (RAI = 4.64). With respect to the mean values of the motivational subscales of the gender groups (Table 5.10), the mean intrinsic regulation of the female workers (3.03) was significantly lower than that of their male peers (3.43). In particular, the mean score of the former on 'enjoy finding valuable solutions from team members' (intri6) was 3.00, whereas that of the latter was 3.60.

The mean values of external and introjected regulation among the female workers (3.73, 3.52) were slightly higher than those of the male workers (3.61, 3.49). Among related subscales (Table 4.11), 'others will respect me more' (exter2) and 'otherwise, feel ashamed of myself' (intro4) are noteworthy. For the first, the male and female workers obtained mean scores of 3.68 and 3.96, respectively. For the second, they obtained mean scores of 3.55 and 3.96, respectively.

These results seem to support a general view of female construction workers in Vietnam that the majority of them work in a construction crew with their relatives; in most cases, with their husbands. Onsite work is recognised as a 'good job' by their families, who very strongly push wives to take on such employment. Thus, the major work motivations of female construction professionals are to receive respect from their families and avoid a sense of shame. Interest in work is not a priority for this group, and the locus of motivation lies outside of them. Put differently, female workers tend to participate in construction tasks to maintain and enhance their role as housewives.

On this basis, then, adopting the RAI as a measure of WA levels is appropriate because this index characterises male and female workers in a clear manner. The use

of the AMI blurs the focus of WA with respect to gender. Research on the role of women in the construction domain is rare, and surveys and analyses of WA among female workers are expected to increase in importance once the responsibilities of women in this industry change.

5.5.2. Second Feature: Work Experience

Two noteworthy characteristics are relevant to work experience: The RAI and AMI scores of the most experienced workers (>10 years) and their least experienced counterparts (<5 years) reflected contrasting degrees of relationships, and statistically significant differences in AMI scores were found among the work experience groups.

5.5.2.1. Characteristics of the Most Experienced Workers

As shown in Table 5.5, the RAI score of the most experienced workers (>10 years) was 4.99—the highest among the scores of the three groups (most experienced, moderate experience, and least experienced). The highest RAI arose from the lowest form of controlled motivation. These workers gained scores of 3.18 and 3.18 on external and introjected regulation, respectively. Of particular interest is the contrast between scores with respect to 'receive good support' (exter9) and 'otherwise, feel ashamed' (intro4), with the workers scoring 3.05 and 3.16 on these items, respectively (Table 5.11). These are significantly lower than the scores of the other two less experienced groups. The most experienced workers earned a score of 3.14 on the item 'rewarded financially' (exter7), which is also significantly lower than those of the other two groups (Table 5.11). This result may be attributed to the higher incomes of the former, who earn an average of 4,369 USD annually. This figure is considerably higher than the average annual income of Vietnamese citizens, which amounted to 2,700 USD in 2019. It is also higher than that of the least experienced workers (<5 years, 3,610 USD) and the workers with moderate experience (5–10 years, 3,792 USD). These results suggest that the locus of work motivation among the most experienced workers does not lie outside.

Furthermore, the most experienced workers scored the lowest in terms of autonomous motivation (i.e., identified, integrated and intrinsic regulation). Their

scores on ‘try to improve my skills’ (iden2) and ‘a chance to learn new things/skills’ (intri4) were 3.22 and 3.08, respectively, which are considerably lower than the scores of the other two groups (Table 5.11). For the most experienced workers, acquiring new skills and displaying enthusiasm in activities diminished in importance. The discussion indicates that although this group was the least constrained by external factors, they were also minimally moved by them.

5.5.2.2. Characteristics of the Least Experienced Workers

The least experienced workers’ (<5 years) RAI score was 4.57, the second highest among the scores of the three groups, as provided in Table 5.5. They exhibited the highest autonomous motivation out of the groups and higher controlled motivation than that shown by their most experienced peers. They scored 3.69 and 3.64 on the items ‘align with my personal values’ (inte5) and ‘enjoy finding valuable solutions from my teammates’ (intri6), respectively. These were the highest scores derived. On the controlled motivation items ‘receive good support’ (exter9) and ‘otherwise, feel ashamed’ (intro4), they earned scores of 3.73 and 3.94 (Table 5.11), respectively, which are considerably higher than those obtained by the most experienced workers. In the RAI, a conventional index of WA, these high scores are counted as negative values. When a newcomer wants to establish himself/herself in the industry, a natural tendency appears to be for this individual to understand and fulfil the expectations of others to avoid disappointing them. Therefore, within substantial autonomous motivation, high controlled motivation represents a development process. The fact that the least experienced workers displayed the highest autonomous motivation and higher controlled motivation than that shown by the other groups implies that pursuing career development as an onsite worker is a favourable start for workers with the least experience in the industry.

5.5.3. Third Feature: The Important Role of WA in Improving CLP

First, the author found a downtrend in CLP with rising work experience (Table 5.8), in contrast to previous studies [112, 184], which discovered a significant impact of the latter on the former. This discrepancy suggests rethinking the practical role of

experience in construction workforce management, particularly in CLP improvement.

Second, both the RAI and AMI revealed WA as a positive and significant contributor to CLP (Tables 5.9.a, b), but the AMI more accurately explained the influence of the former on the latter (H1; $\beta = 0.405$, $p < 0.001$). This finding reflects that WA, particularly as represented by the AMI, is critical to enhancing CLP. To put it another way, an increase in efforts to ensure WA can significantly contribute to CLP improvement. This finding aligns with prior studies, which found that WA significantly advances work performance among employees of Norwegian service organisations [175] and among hotel staff (e.g., employees and supervisors) in the southern region of South Korea [176]. As WA has rarely been discussed in the construction domain, this finding translates to a new theoretical and practical perspective with respect to how CLP can be improved. It also steers construction managers towards a useful direction in the pursuit of effective construction workforce management.

5.5.4. Fourth Feature: Enhancing WA by Promoting Satisfaction with Competence and Relatedness

Previous studies neglected the ways by which WA can be cultivated and maintained—a gap bridged in the current research. A comparison of Tables 5.9.a&b show that the AMI could explain the relationship between BPNS and WA. Competence satisfaction (H3; $\beta = 0.287$, $p < 0.001$) and relatedness satisfaction (H4; $\beta = 0.352$, $p < 0.001$) positively and significantly contributed to the WA of the workers. This finding implies that workers' satisfaction with their competence and relatedness increases autonomy at work. Enhanced satisfaction with competence increases the confidence and effectiveness of workers to undertake and participate in tasks, thereby promoting their autonomy. Enhanced satisfaction with relatedness causes workers to feel that they belong to and are part of a larger collective entity wherein valuable interpersonal relationships are cultivated. These feelings, in turn, promote collaboration among team members and are expected to directly contribute to autonomy improvement at work. The enhancement of satisfaction with competence and relatedness is also a potential mechanism by which autonomy at work can be

cultivated and maintained.

The author expected the workers' sense of choice and psychological freedom at work to promote their autonomy levels (Table 5.9.b), but autonomy satisfaction did not significantly contribute to WA (H2). This result necessitates a careful consideration of differences in autonomy connotations in autonomous motivation and autonomy satisfaction, as demonstrated in [15]. That is, the autonomy connotation in autonomy satisfaction represents individuals' inherent desire to feel volitional and experience a sense of choice and psychological freedom when carrying out an activity [44], whereas the autonomy connotation in autonomous motivation represents the performance of a task because it is enjoyable, optimally challenging or self-endorsed [36].

5.5.5. Observations of Career Development among Vietnamese Onsite Workers

5.5.5.1. General Observations

The author used the AMI as an index of WA to validate H1, H3 and H4. The author found that the satisfaction of competence and relatedness needs enhanced WA, which in turn improved CLP. However, H2 was not validated, as the actual situation was in complete contrast with the supposition: Autonomy satisfaction may have been perceived as a licence to work 'selfishly', thus exerting a negative influence on WA. This finding provides insight into the career development of Vietnamese onsite construction workers. That is, there was a consistent downtrend in CLP, WA, competence satisfaction and relatedness satisfaction but an uptrend in autonomy satisfaction with work experience. The results imply that newcomers, or the least experienced workers, make a good start in pursuing construction as a career but that their most experienced counterparts are not necessarily successful in terms of career development and are underutilised in the construction industry.

5.5.5.2. Unsuccessful Career Development and Underutilisation: A Matter of Insufficient Optimal Challenge

By interpreting key statistics, the author determined the key impediment to successful career development and the driver of underutilisation among the most

experienced workers. In the survey, the author focused on the WA of workers performing simple tasks and operated under the assumption that the most experienced workers participating in the survey are involved in such duties. They obtained scores on the items 'feel confident that I can do things well' (CS4; mean value = 3.49) and 'have sufficient work-related skills or knowledge onsite' (CS6; mean value = 3.54) that were as high as those of the other two groups. Their overall autonomy satisfaction score was the highest. They obtained significantly lower scores on overall external and introjected regulation than those of the other two groups, indicating that the most experienced workers have extensive experience in completing simple tasks. They receive recognition from others and are empowered by supervisors as senior workers. They feel a sense of psychological freedom to do these tasks. Correspondingly, respect, financial rewards and support from others are not strong incentives for them because they already enjoy these benefits. They do not have to prove themselves because they are already established professionals.

Nevertheless, they differed in terms of 'face'. Their scores on the items 'can successfully complete difficult or challenging tasks' (CS2; mean value = 3.35) and 'feel effective in what I do onsite' (CS5; mean value = 3.22) are the lowest in their group, which means that they have encountered only limited opportunities to expose themselves to new skills or knowledge. These are considered causes of the fact that they garnered the lowest motivation scores on 'try to improve my skills in my works' (iden2; mean value = 3.22), 'very meaningful for me' (inte2; mean value = 3.27) and 'have a chance to learn new things/new skills (intri4; mean value = 3.08). In summary, a core reason for unsuccessful career development and underutilisation among the most experienced workers was the insufficient optimal challenge that they had encountered in their career development.

5.5.6. Policy Recommendations for Enhancing CLP

To enhance CLP as well as workforce management effectively, promoting WA of workers and effective utilization of the experienced workers play an important role. These would stimulate personal happiness, advance their career development and afford these employees industrial benefits. In this respect, the author puts forward

three policy recommendations: the effective organisation of work crew members, the improvement of training and the improvement of site amenities.

5.5.6.1. Effective Organisation of Work Crew Members

Generally, construction managers tend to assign high-skill tasks to experienced and skilled workers onsite and assign simple or heavy tasks to younger and non-skilled workers. This arrangement can achieve the highest teamwork performance because younger workers inadequately or ineffectively accomplish complicated responsibilities, while experienced and skilled workers may feel discouraged by simple or unchallenging tasks. Non-skilled workers can also improve their experience by accumulating practical skills from skilled veterans. Optimal teamwork in a construction crew necessitates that the composition of skilled and non-skilled workers participating in a task be satisfactorily determined on the basis of task characteristics. In addition to transferring real-world experiences and practical skills to young workers during task implementation, experienced and skilled workers play a vital role in problem solving, which can suddenly occur under uncertain situations onsite, even during the implementation of simple tasks.

In sum, construction professionals should pay more attention to the arrangement or designation of tasks to each worker on the basis of his/her competencies and job characteristics to ensure sufficient optimal challenges for all employees. An optimal challenging task can enable both newcomers and experienced workers to feel excited and enthusiastic about their work, and thereby help them maintain or even enhance their autonomous motivation. Consequently, their WA and CLP can be enhanced.

5.5.6.2. Improvement of Training

Theoretically, training is a promising way to promote competence satisfaction because workers can acquire the skills necessary to improve their competencies, which in turn elevates their self-confidence and mastery. The survey uncovered that the current training programmes provided to the participating workers are ineffective. As shown in Table 5.10, a significant difference in autonomy satisfaction scores was found between trained (mean = 3.89) and untrained (mean = 3.39) workers, but no such difference in competence satisfaction scores existed between them (mean values

= 3.46 and 3.49, respectively). These findings suggest the necessity of rethinking the factual role of training in construction workforce management. In Vietnamese construction practice, professional training onsite is very limited. Contractors rarely offer occupational training to their workers because training cost is a primary obstacle, and most tasks onsite typically require little skill and are therefore rapidly learned [185]. Hence, contractors organise only short training courses and only when it is truly necessary, such as when high-skill tasks are to be completed amid the absence of skilled workers who can be recruited for this purpose.

A promising approach to tackling the above-mentioned issues is on-the-job training (OJT). Implementing effective and efficient OJT can give rise to many benefits [186], such as reduced training costs, faster training and adaptation to real-world circumstances and enhanced teamwork. Effective OJT involves experienced workers who are willing to share their practical experiences and problem-solving abilities with their peers. Such sharing can elevate the sense of responsibility among crew members and help them discern their important roles in a crew. Consequently, they become increasingly interested in and enthusiastic about participating in tasks. This promotes the autonomy at work of workers, which achieves the desired productivity.

5.5.6.3. Improvement of Site Amenities

In the survey, responses to one question pointed to a serious problem in the Vietnamese construction industry: ‘Because I work at safe and healthy conditions’ (exter8). The scores of the least and moderately experienced workers on this item were 3.67 and 3.57, respectively, and that of the most experienced workers was 3.08. These differences imply the existence of hazardous working conditions for onsite workers, who are compelled to grapple with unsafe situations and inclement weather. Senior workers are more vulnerable to these undesirable conditions. Sustainable labour management requires safe working conditions. Currently, an important issue in the Vietnamese industry is implementing measures for dealing with heat stress. Solving this issue can help workers work more productively.

Moreover, mobility matters to the construction workforce, and in many cases,

workers in a crew not only work together, but also live together on a construction site. Therefore, providing good site amenities (e.g., labour camp facilities, site services and hygiene and sanitation) [187] can advance the establishment of strong ties between team members and supervisors, minimise potential conflicts and ensure harmonious communal living. Under these conditions, workers may feel closely connected with others, rendering them comfortable and happy onsite. A good site amenity also eliminates the risk of occupational diseases, thus ensuring workers' health, particularly among older groups of workers. This contributes to improving their productivity onsite.

5.5.7. Optimality of Scoring Protocols

This section discusses the optimality of WA scoring protocols. The author posits certain conditions as necessary to achieving optimality. Specifically, a given measure should enable the following measures:

1. The separation of groups with different attributes;
2. The characterisation of each group;
3. The further characterisation of each group by identifying the relationship among influencing factors, WA and performance;
4. The identification of latent characteristics (i.e., advantages and disadvantages) and the proposal of improvement measures;
5. The complementing of WA indices.

The RAI and AMI results described in the previous sections highlighted the noteworthy characteristics of each group of workers in terms of gender and work experience. The first four conditions seemed to have been satisfied. For the fifth condition, the author proposed a motivation matrix and formulated conceptual and physical interpretations of the RAI and AMI. These perspectives are illustrated in Figure 5.2.

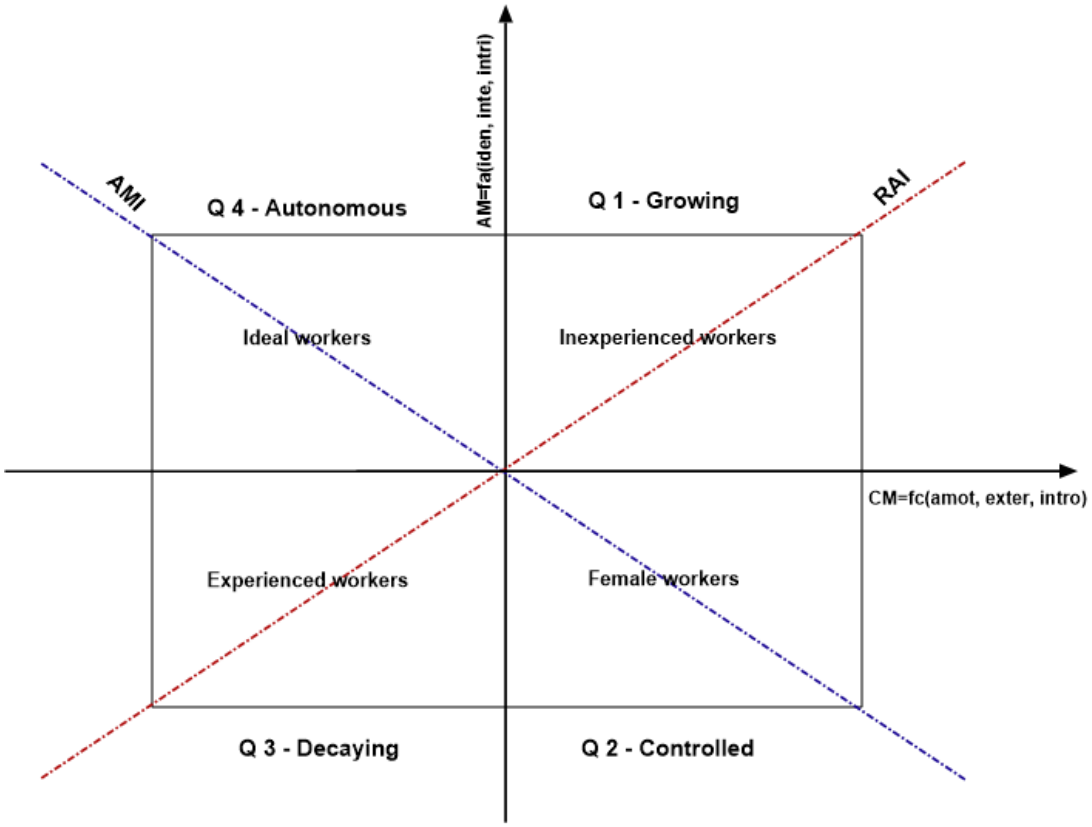

Figure 5.2. Motivation matrix

The motivation matrix consists of two axes: the x-axis, which represents controlled motivation (CM), and the y-axis, which represents autonomous motivation (AM). Here, controlled motivation can be flexibly calculated on the basis of amotivation, external regulation and introjected regulation: CM = fc (amot, exter, intro). Similarly, autonomous motivation can be calculated with identified, integrated and intrinsic regulation as bases: AM = fa (iden, inter, intri). Correspondingly, the motivational space of workers can be divided into four quadrants.

The results and discussions sections showed that the RAI successfully distinguished between the male and female workers, but it could not achieve this distinction in terms of experienced and inexperienced workers because it is insufficiently precise for this purpose. This droves us to develop and introduce the AMI as an auxiliary index. The results showed that the AMI was sufficiently precise in distinguishing the examined groups on the grounds of work experience. As conceptually visualised in Figure 5.2, the RAI and AMI generally classified the groups under specific quadrants as follows:

- The inexperienced workers had high controlled and autonomous motivation, locating the largest number of them in the first quadrant (Table 5.13). Because they have favourably initiated their career development as onsite workers, the author refers to this quadrant as the growing quadrant.
- The female workers had high controlled and low autonomous motivation, positioning the largest number of them in the second quadrant (Table 5.12). Because the major driver of construction work among these workers is controlled motivation, the author calls this quadrant the controlled quadrant.
- The experienced workers exhibited low controlled and autonomous motivation, thus locating the largest number of them in the third quadrant (Table 5.13). Because they are not necessarily successful in their career development and are underutilised in the construction industry, the author labels this quadrant the decaying quadrant.
- The fourth quadrant is called the autonomous quadrant because it represents workers who had high autonomous motivation but low controlled motivation. This situation seems ideal for workers in the construction industry.

In the course of career development, inexperienced workers may move from the first quadrant to the third quadrant, resulting in a decrease in WA and CLP. Thus, in accordance with the motivation matrix, measures should be implemented to ensure that both experienced and inexperienced workers move to the ideal stage in their autonomy, that is, the fourth quadrant. Inexperienced workers seem to require a given amount of time to move to the fourth quadrant because they are newcomers, even as they have had a good start in their career development. Newcomers are likely to be satisfied with external factors, such as income and respect, which diminish controlled motivation, similar to what transpires among experienced workers. An important measure, therefore, is to help these workers maintain and enhance their autonomous motivation. Put differently, a promising approach is to prevent them from falling into the third quadrant through reasonable policies that can support their successful career development.

As can be seen, the introduction of the AMI, together with the RAI, enabled us

to more clearly and comprehensively identify latent and deeply rooted problems, their causes and their potential remedies. This is considered an important aspect of optimality.

Table 5.12. Ratios of groups in quadrants in the case of RAI

RAI		Q1	Q2	Q3	Q4	Total
Work experience	< 5 years	30	17	26	21	94
		32%	18%	28%	22%	100%
	5-10 years	31	22	14	17	84
		37%	26%	17%	20%	100%
	>10 years	4	5	16	12	37
		11%	14%	43%	32%	100%
Gender	Female	9	15	4	0	28
		32%	54%	14%	0%	100%
	Male	56	29	52	50	187
		30%	16%	28%	27%	100%

Table 5.13. Ratios of groups in quadrants in the case of AMI

AMI		Q1	Q2	Q3	Q4	Total
Work experience	< 5 years	34	20	21	19	94
		36%	21%	22%	20%	100%
	5-10 years	31	18	22	13	84
		37%	21%	26%	15%	100%
	>10 years	7	5	16	9	37
		19%	14%	43%	24%	100%
Gender	Female	7	8	8	5	28
		25%	29%	29%	18%	100%
	Male	65	35	51	36	187
		35%	19%	27%	19%	100%

5.6. Conclusions

This research quantitatively measured the WA of workers by adopting different scoring protocols. A novel model was developed to examine the role of WA in CLP enhancement, and the ways by which WA can be cultivated and maintained through BPNS were explored. Data collected from 215 onsite workers in Vietnam were illuminated via principal component analysis and SEM.

The author probed into the effects of different scoring protocols in measuring WA through the RAI and AMI. The AMI was developed and justified as an auxiliary index, and five necessary conditions for determining the optimum WA scoring protocol were proposed. In addition, a motivation matrix was put forward to represent conceptual and physical interpretations of the RAI and AMI. Specifically, the RAI explains differences in WA between genders, while the AMI more precisely accounts for dissimilarities in WA on the basis of work experience. The matrix also revealed the specific attributes of each surveyed group. First, many female workers in Vietnam engage in construction work to maintain and enhance their role as housewives. Second, newcomers are making a good start in their career development. Third, the most experienced workers are less enthusiastic than other groups about participating in simple tasks.

Chapter 6. Factors Constraining Work Motivation in Construction Projects

6.1. Introduction

Construction industry, in many developing countries like Vietnam, is facing numerous challenges, but one of the most problems is low labor productivity [184]. This is the main cause of project cost overruns, delays and decrease in the chance of implementing construction projects successful [27, 188, 189]. Increasing labor productivity, therefore, has become an urgent issue, being a vital success factor for construction project completion which supports construction companies can survive in the current volatile and highly competitive [109]. Since construction is a labor-intensive industry and employs a large number of unskilled workers, construction productivity primarily depends on the workforce's effort and performance [190]. Construction managers can tackle low CLP matters by paying more attention to the key factors that contribute to this issue early on. Improving CLP, thus, has been frequently discussed within the research community and practitioners; consequently, various factors affecting the productive capacity of the labor force have been identified and assessed to reveal reasonable strategies for effectiveness and efficiency of construction workforce management, enhancing CLP particularly [19, 191].

Previous studies emphasized the importance of human-related factors affecting their productivity in construction projects. These factors, for example, experience [22, 92]; attitude [163, 192, 193]; self-confidence [193, 194]; behavior [163, 195]; motivation [22, 135, 196, 197]; aptitude [193, 198]; solving problem ability [17, 193]; and desirable [193]. Among them, motivation was demonstrated as a significant element affecting labor productivity, which is one of the most driving factors for the overall productivity of a construction organization [26, 196]. According to [172], individuals' cognitive, intention and behavior are influenced by a so-called motivation to succeed and overcome work challenges while pursuing specific goals. As a result, if workers are to perform well their tasks onsite, they must be motivated [196].

Although previous studies have identified and assessed various motivational

factors that influence CLP, research on factors constraining work motivation in construction projects has been insufficiently discussed. Therefore, it is vital to investigate the various barriers that constrain work motivation of the construction workforce in both dimensions of severity level and their frequency of occurrence. This can provide a more realistic picture in assessing these barriers to worker's motivation participating in construction projects. The findings will contribute to minimizing and eliminating the negative effects in order to improve work motivation and labor productivity; consequently, increasing the chance of implementing construction project successfully.

6.2. Factors constraining work motivation in construction projects

Despite the significant technological advancements, construction remains an intensive labor industry [19]. Enhancing work motivation of construction workforce, therefore, is very important for implementing construction project performance successfully. In addition, [199] emphasized that motivation issues should be identified and solved appropriately to enhance project performance. Thus, many studies have focused on motivational or demotivational factors affecting CLP.

[200] adopted percentage analysis to identified and ranked 7 demotivational factors and their effects on the productivity of workers in civil engineering projects in Hong Kong. The five most important factors assessed by them were (1) rework; (2) overcrowded work areas; (3) crew interfacing; (4) tool unavailability; (5) inspection delays.

In Qatar, [110] managed 10 motivational factors affecting labor productivity in the construction industry. They used Relative Importance Index (RII) to rank these factors and were able to list the five most significant demotivational factors affecting CLP: (1) poor work conditions, (2) poor administration policy, (3) poor work relationship, (4) lack of communication, and (5) lack of appreciation. Another study of [201] identified and assessed 38 demotivational factors influencing the productivity of construction project managers in Qatar. By adopting RII approach, (1) lack of financial incentive schemes, (2) slow decision-making process by owners, (3) remuneration scale, (4) delay in responding to Requests for Information (RFI), and

(5) shortage of skilled labor force, were the five significant demotivators.

[135] adopted RII approach to assess 25 motivational factors affecting CLP based on workers and managers perception in Azerbaijan construction industry. Accordingly, (1) underpayment for the work done, (2) bad treatment by the supervisors, (3) unsafe work conditions, (4) changing on workmates, and (5) colleagues' aggressive management style, were top most demotivational factors for workers; whereas, top most demotivational factors for managers included: (1) chaos/adhocracy, (2) unsafe work conditions, (3) colleagues' aggressive management style, (4) incompetent colleagues, and (5) underpayment for the work done.

[202] identified and ranked 16 motivational factors affecting labor productivity in Nigerian construction industry based on their mean values. Accordingly, (1) job security, (2) good salary, (3) compliance with safety, (4) appreciation of effort, and (5) bonus were highlighted as the five most influential factors.

In Jordan, 16 motivational factors on construction professionals productivity were determined and assessed by [131]. By adopting the RII approach, they concluded five significant motivational factors affecting CLP were (1) personal growth/career improvement, (2) pay on time, (3) decision-making ability, (4) decent and respectful job, (5) rewards. Another study of [203] to rank 10 demotivating factors influencing productivity in Jordanian residential construction projects. Accordingly, (1) rework, (2) specifications and quality requirements, (3) lack of training offered to labor, (4) too many variation/change orders during execution, and (5) shortage of equipment were the most important factors affecting CLP.

[108] identified 37 basic motivational factors on construction workforce productivity in Turkey. They used RII method to ranked these factors, (1) quality of site management, (2) on-time payment, (3) material management, (4) systematic flow of work, and (5) supervision were highlighted as the five most influential factors.

[204] determined 9 motivational and 10 demotivational factors affecting CLP in India. By adopting their mean values, they found that (1) lack of recognition, (2) poor salary, (3), poor work condition, (4) disrespect from managers; (5) poor relationship with colleagues were highlighted as the five most demotivational factors, whereas, (1) job training, (2) good salary, (3) recognition from peers, (4) growth

opportunities, and (5) challenging task were the five significant motivational factors affecting CLP.

A comprehensive literature review was conducted by collecting and studying relevant academic papers considering the various (de)motivational factors affecting CLP. In this study, the selection process of exploring factors constraining work motivation in construction projects involved two steps. First, several possible barriers were identified based on relevant previous studies on this topic. Second, the selected barriers were subsequently assessed by a group of local industry experts, construction practitioners (e.g., project managers, supervisors, workers) to validate their applicability and significance to the local industry. Accordingly, a total of 35 factors constraining work motivation in construction projects in Table 6.1 were finally shortlisted.

Table 6.1. Factors constraining work motivation in construction projects

Code	Barriers	Sources
C1	Bad treatment by supervisors	[135, 204]
C2	Changing on workmates	[135, 203]
C3	Delay in responding to Requests for Information	[201]
C4	Delay in payment	[108, 205]
C5	Health personal problems	[108, 201, 203]
C6	Inadequate managerial competence	[201, 203, 204]
C7	Inappropriate evaluation and feedback	[110, 201]
C8	Inclement weather	[108, 201, 203]
C9	Incompetent teammates	[135]
C10	Laborers' disloyalty	[108, 204]
C11	Lack of cooperation	[135, 204]
C12	Lack of discipline on site	[108]
C13	Lack of financial incentive schemes	[108, 201]
C14	Lack of participation in decision making	[108, 135]
C15	Lack of periodical increment	[201]
C16	Lack of professional training and advanced learning opportunities	[108, 201, 203]
C17	Lack of recognition of efforts	[135, 201, 204]
C18	Material unavailability	[135]
C19	Not enough challenging task	[135]
C20	Not enough responsibility	[108, 135]
C21	Overcrowded work areas	[135, 200]
C22	Overloads and working long hours	[108, 135, 201, 203, 204]
C23	Personal life interference	[200, 201, 204]
C24	Poor communication	[110, 135, 204]
C25	Poor inspection and supervision	[135, 200, 201, 203]
C26	Poor relationship	[110]
C27	Poor work conditions	[110, 135, 204]
C28	Quarrels and hassles	[135]
C29	Rework	[108, 135, 200, 201, 203]
C30	Strict company policy	[201, 204]
C31	Tool unavailability	[135, 200, 203]
C32	Underpayment for the work done	[135]
C33	Unrealistic contract duration	[201]
C34	Unskilled workforce	[201]
C35	Work dissatisfaction	[108, 203]

The first study examined the impacts of three basic psychological needs satisfaction on three types of work motivation separately [38], the author also examined these impacts on work autonomy (i.e., integrating three types of work motivation into one component) in the second study [39]. However, in fact, many factors in addition to BPNS may affect work motivation of construction workers. Hence, the third study managed 35 factors constraining work motivation in construction projects, as shown in Table 6.1. Previous studies have categorized above-mentioned factors into different groups such as human-related factors, management-related factors, technical-related factors, and economy-related factors. However, this study introduces another grouping perspective based on BPNS. Accordingly, 35 factors were categorized into groups as follows:

- Autonomy-related factors constraining work motivation, including: Lack of discipline on site, lack of participation in decision making, not enough responsibility, and work dissatisfaction.
- Competence-related factors constraining work motivation, including: Health personal problems, incompetent teammates, lack of professional training and advanced learning opportunities, not enough challenging task, and unskilled labor force.
- Relatedness-related factors constraining work motivation, including: Lack of cooperation, laborers' disloyalty, lack of recognition of efforts, personal life interference, poor communication, poor relationship, quarrels and hassles.
- Management-related factors constraining work motivation, including: Bad treatment by supervisors, changing on workmates, inadequate managerial competence, inappropriate evaluation and feedback, poor inspection and supervision, and strict company policy.
- Technical-related factors constraining work motivation, including: Delay in responding to Requests for Information, material unavailability, overcrowded work areas, overloads and working long hours, rework, poor work conditions, tool unavailability, and unrealistic contract duration.
- Economic-related factors constraining work motivation, including: Delay in payment, lack of financial incentive schemes, lack of periodical increment,

and underpayment for the work done.

- External factors constraining work motivation, including: inclement weather.

6.3. Research objectives

Previous studies have investigated motivational or demotivational factors influencing CLP in many countries. However, very rare studies have identified and assessed key barriers to work motivation in construction projects. This knowledge gap hinders further efforts to explore new determinants that promote work motivation and increase CLP.

The frequency and importance of the factors vary from project to project or nation to nation, and even within the same project, depending on circumstances [206]. The majority of factors affecting CLP differ from country to country because they are industry-specific, and the differences are influenced by the socio-cultural, legislative, and regulatory environments [207]. In the Vietnamese construction industry, the literature on work motivation or CLP issues is still very limited. This leads to ambiguity in both the research community and the Vietnamese construction industry regarding the practical importance of exploring factors constraining work motivation in construction projects.

To assess motivational or demotivational factors affecting CLP, previous studies have adopted several approaches such as mean, the RII by only using the level of influence without considering the frequency of occurrence of each factor. This could not provide a comprehensive picture to reflect the fact role of these factors in construction projects.

This study aims to fill these gaps by investigating factors constraining work motivation in construction projects. These factors were assessed by adopting a risk mapping approach based on considering severity level and their occurrence frequency in the Vietnamese construction industry context. The results of the study have evidential uniqueness, methodological novelty, and contribute to the knowledge of construction workforce motivation barriers, thus making a visible contribution to the science of human resources management.

6.4. Results

6.4.1. Internal Consistency of the Questionnaire

The Cronbach's alpha is a coefficient to measure the reliability of internal consistency that assumes the same thresholds but yields lower values than the reliability of the composite. This aimed to compute the Cronbach's alpha coefficient to confirm that the criteria associated with the Likert's scale measure each variable that was indeed intended to be measured. The study of [208] explained that Cronbach's alpha coefficient measures the extent to which answers to survey questions correlate with each other, which means α estimates the proportion of variance that is systematic or consistent in a set of survey responses. The standard for evaluating the level of relevance of the model, where Cronbach's alpha is higher than 0.6, questionnaires are generally accepted as accurate [209]. Cronbach's alpha coefficient is computed by Eq. (1) as follows:

$$\text{Cronbach's alpha } \alpha = \frac{N.C}{v+(N-1).C} \quad (1)$$

Where:

N represents the number of indicators of the items;

C the coefficient of correlation of the average nonredundant indicator (i.e., the mean of the lower or upper triangular matrix);

v is the average variance.

The data collected in this work were analysed using the Statistical Package for the Social Sciences (25.0, IBM® SPSS®). The analysis resulted in a Cronbach coefficient of 0.958, which validates the reliability of internal consistency.

6.4.2. Risk Mapping Results

In this study, the risk mapping typically used two intersecting criteria (Table 6.2):

- Impact: the level of severity that the risk will have.
- Likelihood: the level of probability that the risk will occur.

Table 6.2. Severity and frequency rating scale

Level	1	2	3	4	5
Severity	No severity	Low severity	Moderate severity	Strong severity	Very strong severity
Frequency	Unlikely to happen	May happen	Likely to happen	Very likely to happen	Certain to happen

This study decided the limits of each zone were determined based on previous studies that applied the risk mapping [103, 104]. Accordingly, the low-risk zone would have a severity times frequency (SF) value from 1 to less than 10, the moderate-risk zone would have a value from 10 to less than 14, and the high-risk zone would have a value from 14 to 25. Three different zones of the risk mapping are described in Table 6.3 as follows:

Table 6.3. Criteria for each zone of risk mapping

Zone	SF value	Description
Low-risk	1 - 10	• These risks are low level of severity and frequency. • They are not big concern but does not mean that they are not important. • Managers can get to them after the rest of the risks have been mitigated.
Moderate-risk	10 - 14	• These risks are moderate level of severity and frequency. • They are not a high priority and are not known to be used to develop a policy to solve urgent problems. • Managers can consider these risks reasonably.
High-risk	14 - 25	• These risks are high level of severity and frequency. • They require an immediate response and high level of control. • Managers consider these risks to make reasonable policies to solve urgent problems.

To calculate SF, the severity index (SI) and the frequency index (FI) are estimated by using mean value of each barrier. The SF provides better ranking results since it reflects the effects of each barrier and its probability of occurrence altogether.

This way, the effect of each barrier to work motivation in construction projects is estimated more realistically. The SF will be calculated according to equation (6.1) as follows:

$$SF = \text{Severity index (SI)} \times \text{Frequency index (FI)} \quad (6.1)$$

Table 6.4 indicates the analysis of 35 factors constraining work motivation in construction projects. Each barrier's average severity level and its frequency of occurrence, the multiplication, and the risk zone is based on all completed responses.

Table 6.4. The results of barriers to work motivation in construction projects.

Code	Barrier	Severity (Mean)	Frequency (Mean)	Severity x Frequency (SF)	Risk Zone
C1	Bad treatment by supervisors	3.79	3.35	12.68	Moderate-risk
C2	Changing on workmates	3.42	2.47	8.44	Low-risk
C3	Delay in responding to Requests for Information	3.60	2.43	8.76	Low-risk
C4	Delay in payment	3.92	3.67	14.37	High-risk
C5	Health personal problems	3.81	3.64	13.87	Moderate-risk
C6	Inadequate managerial competence	3.88	3.50	13.60	Moderate-risk
C7	Inappropriate evaluation and feedback	3.76	3.47	13.04	Moderate-risk
C8	Inclement weather	3.44	3.48	11.97	Moderate-risk
C9	Incompetent teammates	3.77	3.07	11.56	Moderate-risk
C10	Laborers' disloyalty	3.72	2.30	8.57	Low-risk
C11	Lack of cooperation	3.39	3.44	11.67	Moderate-risk
C12	Lack of discipline on site	3.75	3.45	12.92	Moderate-risk
C13	Lack of financial incentive schemes	3.91	3.91	15.26	High-risk
C14	Lack of participation in decision making	3.76	2.24	8.43	Low-risk
C15	Lack of periodical increment	3.98	3.34	13.28	Moderate-risk
C16	Lack of professional training and advanced learning opportunities	4.30	3.64	15.63	High-risk
C17	Lack of recognition of efforts	3.76	3.24	12.17	Moderate-risk
C18	Material unavailability	3.60	3.71	13.36	Moderate-risk
C19	Not enough challenging task	3.56	2.67	9.48	Low-risk
C20	Not enough responsibility	3.77	3.41	12.86	Moderate-risk

Code	Barrier	Severity (Mean)	Frequency (Mean)	Severity x Frequency (SF)	Risk Zone
C21	Overcrowded work areas	3.42	2.40	8.22	Low-risk
C22	Overloads and working long hours	3.40	3.50	11.89	Moderate-risk
C23	Personal life interference	3.73	2.46	9.15	Low-risk
C24	Poor communication	3.40	3.22	10.94	Moderate-risk
C25	Poor inspection and supervision	3.70	3.47	12.85	Moderate-risk
C26	Poor relationship	3.41	3.55	12.11	Moderate-risk
C27	Poor work conditions	3.93	3.76	14.79	High-risk
C28	Quarrels and hassles	3.38	3.42	11.56	Moderate-risk
C29	Rework	3.60	3.52	12.66	Moderate-risk
C30	Strict company policy	3.83	2.33	8.92	Low-risk
C31	Tool unavailability	3.00	3.80	11.39	Moderate-risk
C32	Underpayment for the work done	3.90	3.55	13.85	Moderate-risk
C33	Unrealistic contract duration	3.78	2.31	8.73	Low-risk
C34	Unskilled workforce	3.83	3.76	14.40	High-risk
C35	Work dissatisfaction	3.83	3.74	14.33	High-risk

6.5. Discussions

As provided in Table 6.4, among 35 identified barriers, 9 barriers were located in the low-risk zone which revealed these constraints have a low impact on work motivation of workers participating in construction projects; 20 barriers were located in the moderate-risk zone, representing medium risk factors, whereas, 6 constraint factors were located in the high-risk zone of the risk mapping. This means these barriers have the highest negative impact on work motivation in construction projects. These 6 barriers assessed in the present study were of great severity, and their negative impacts should be taken into consideration. Accordingly, the surveyed respondents ranked the following barriers as the most significant constraints were (1) lack of professional training and advanced learning opportunities, (2) unskilled workforce, (3) lack of financial incentive schemes, (4) payment delay, (5) poor work conditions, and (6) work dissatisfaction.

6.5.1. Impacts of lack of professional training and advanced learning opportunities, and unskilled workforce on work motivation

Lack of professional training and advanced learning opportunities were assessed as a key barrier to work motivation. Promoting a worker's participation in designated tasks on site may become easier if managers provide opportunities to him/her that will advance his/her professional standing and skills. Low productivity in construction projects are due partly to low levels of professional training [108]. Lack of professional education for the construction workforce is now a reality in Vietnam. This may be a cause of the unskilled workforce barrier being assessed by workers as high severity and its probability of occurrence in construction projects. In fact, unskilled and poorly trained laborers are commonly characterized by low and faulty outputs coupled with unjustifiably high inputs. Their outputs, in addition, are almost always rejected, either in whole or in part, by inspectors, resulting in disruptive rectifications and expensive repairs, which can lead to recurring slippage in construction schedules [201]. In other words, the unskilled workforce may consume more time to perform the job with larger room for mistakes and reworks. Consequently, employing low-skilled workers may result in lower work performance

and increase project cost.

Due to the insufficient professional construction workforce, recruiting skilled laborers is a challenge for many Vietnamese contractors. To meet the demands and fill the skill gap, it is essential for construction companies to invest in human resource development programs that increase the availability of a skilled pool of professional workers through short training programs, on-the-job training, or seminars in occupational establishments. As derived in Chapter 5, the author recommended that the improvement of training as a meaningful policy to support contractors in improving workers' competencies and proficiencies, achieving optimal work performance, reducing micromanagement, or creating a sustainable workforce for the construction industry [39].

6.5.2. Impact of lack of financial incentive schemes on work motivation

Lack of financial incentive schemes, which come in the high-risk zone, has a negative impact on work motivation in the construction workforce. This finding was in the line with [201] which shown that this barrier was the most demotivational factors affecting productivity of construction project managers in Qatar. Being rewarded, even if not financially exclusive is a key motivational factor that improved labor productivity [131]. In addition, [210] explained that it is necessary to promote and reward construction laborers as a way of enhancing motivation and work satisfaction in order to improve labor productivity. Construction managers could consider providing financial incentive schemes as a means of demonstrating appreciation for the employees which shows that the managers valued their tasks. In fact, financial incentive schemes belong to external regulation (one type of controlled motivation) according to SDT. This again reinforces and strengthens the conventional view, which identifies the role of controlled motivation with respect to improving CLP, as discussed in Chapter 4.

6.5.3. Impact of payment delay on work motivation

Delay in payment was assessed as a significant barrier to work motivation of workers when they participate in construction projects. Delaying the salaries of the

workers may lead to a decrease in their motivation because they are more unwilling to perform designated tasks in an efficient manner, resulting in a low productivity level. This finding was supported by [108, 205] who claimed that payment delay is most influential factors affecting CLP in Turkey and Zimbabwe. In addition, payment delay can influence every aspect of a construction project, interrupting the workflow which leads to construction project performance decrease. Particularly, the income of laborers or suppliers is expensed by contractors that may be delayed since the late payments from the owners because there is inadequate cash flow to support construction project organization expenses, especially for those contractors who are not financially competent. This phenomenon can impact the availability of labor, supplying materials, motivation, and loyalty of laborers, and the communication between laborers and contractors [211]. Payment on time is one of the primary principles of any working agreement. While adequate working facilities can reduce to some extent the demotivating effects of delay in payment simply cannot.

6.5.4. Impact of poor work conditions on work motivation

Poor work conditions were considered as a significant factor constraining work motivation in construction projects. [131] claimed that a good work environment is a key factor for the success of any task. Onsite, a better work condition enables workers to perform their tasks harder and more efficiently and effectively in their tasks. Ambient temperature, lighting condition, ventilation, air quality, facilities on site such as restrooms, food, and rest areas are important to motivate them willing to participate in tasks. Working in a bad condition will only sequence negative results due to construction works are physically and mentally demanding; hence, workers should be working in a good work environment to achieve the highest performance [212, 213]. Specifically, as derived in Chapter 5, the author recommended that the improvement of site amenities as a meaningful policy to support contractors in providing good site amenities [39]. This can contribute to eliminate the risk of occupational diseases (i.e., ensuring workers' health), advance the establishment of strong ties between team members and supervisors, minimize potential conflicts and ensure harmonious communal living. Consequently, work motivation of workers,

especially autonomous motivation, can be enhanced, resulting in higher productivity.

6.5.5. Impact of work dissatisfaction on work motivation

Work dissatisfaction was considered a high-risk factor constraining workers' motivation to participate in construction projects. This barrier was considered as an influential factor causing construction employees' absenteeism consequence many challenges which construction projects have been facing, such as delayed project completion and cost overruns [214]. The study of [215] identified some causes of job dissatisfaction of construction workers were predominantly related to the adverse personal health and quality of life; whereas, [214] stated that lack of development opportunities, poor relationships with teammates or supervisors, and unchallenging work, were the most influential elements causing worker's dissatisfaction. When workers feel satisfied with their work, this may result in higher productivity, enhance work motivation, and promote collaboration which contributes to construction project implementation successfully.

6.6. Conclusions

This study aimed to identify and assess the most influential work motivation barriers in construction projects. A literature review was carried out to reveal a list of 35 barriers. The data was collected from 215 workers in Vietnam by using the questionnaire survey to investigate the severity level and occurrence frequency of barriers. A Cronbach's test was adopted to validate the reliability of internal consistency. The risk mapping approach was used to measure the severity level and occurrence frequency of each barrier. The results showed that the most significant constraints on work motivation in construction projects were: (1) lack of professional training and advanced learning opportunities, (2) unskilled workforce, (3) lack of financial incentive schemes, (4) payment delay, (5) poor work conditions, and (6) work dissatisfaction.

Chapter 7. Conclusions, Implications, and Limitations

This study was conducted to identify the important roles of AM and WA with respect to improving CLP. To do so, the author developed novel models to examine proposed research hypotheses through data collection from 215 masonry and rebar workers in construction sites in Vietnam.

The first study developed a novel model for assessing the effects of engaging leadership, three basic psychological satisfaction, work motivation and work engagement on CLP. The validity and reliability of the scales, convergent validity, and the model's GoF were tested through reasonable techniques, such as Cronbach's alpha analysis, EFA, and SEM. The SEM results showed several interesting and valuable findings, in addition to reinforcing the traditional view, which emphasized the role of controlled motivation (CM) in CLP improvement. First, the important role of AM in proving CLP was identified. Second, to improve AM and CLP, the satisfaction of competence and relatedness play vital roles. These findings provide a new perspective on both industry and academics with respect to how CLP can be enhanced, as well as how AM can be generated and maintained. Finally, the "negative legacy" of the construction industry was identified. This feature implied that the older and more experienced, but not necessarily skillful, workers perceived AS as being achieved through selfish work, resulting in an obstacle to productivity improvement and the promotion or maintenance of work motivation. Selfish work is a novel factor that negative contributes to CLP.

In the second study, the author quantitatively measured the WA level of workers by adopting RAI and AMI that was developed in this research. The results showed the different effects of two of these scoring protocols in measuring WA. Specifically, the RAI explains differences in WA between genders, while the AMI more precisely accounts for dissimilarities in WA on the basis of work experience. In addition, the author developed a new model by which to discover the function of WA in increasing CLP and determined the ways through which WA can be cultivated and maintained. The SEM was conducted to examine the effects of WA on CLP. The results indicated that WA positively and significantly contributed to CLP. Promoting WA required

paying attention to the competence and relatedness satisfaction of the workers. Furthermore, latent and potentially extensive labor management-related problems were identified, namely, unsuccessful career development and the underutilization of experienced workers. Three meaningful policy recommendations were put forward to solve the aforementioned problems and improve CLP: the effective organization of crew members, the improvement of training, and the improvement of site amenities. In practical terms, the findings support the introduction of reasonable policies that advance the career development of workers, promote WA and improve CLP. These achievements, in turn, significantly advance effective and sustainable construction workforce management.

The third study managed 35 factors constraining work motivation in construction projects. This study differs from past studies in CLP research by investigating the severity level and occurrence frequency of barriers to work motivation in construction projects and provides a more realistic ranking of these factors by adopting a risk mapping approach. The results indicated that the following barriers as the most significant factors constraining work motivation in construction projects: (1) lack of professional training and advanced learning opportunities, (2) unskilled workforce, (3) lack of financial incentive schemes, (4) payment delay, (5) poor work conditions, and (6) work dissatisfaction.

7.1. The core findings of this study

This study explored several valuable findings relevant to effective and sustainable construction workforce management, improving CLP particularly.

- Developed a novel model for assessing the effects of engaging leadership, three basic psychological satisfaction factors (i.e., autonomy, competence, and relatedness), and work motivation on CLP.
- Reinforced the conventional view, that is, the significant role of CM in CLP improvement.
- Identified that AM plays an important role in improving CLP as the “new light of hope” for the effective and sustainable workforce management of the Vietnamese construction industry.

- Identified the “negative legacy” of the Vietnamese construction industry.
- Identified that competence satisfaction and relatedness satisfaction played a key role in enhancing AM.
- To improve CLP, construction managers should pay more attention to enhancing autonomous motivation, promoting satisfaction with competence and relatedness, and reducing selfish work, which is a novel factor that negatively contributes to CLP.
- Introduced and developed new scales for novel variables affecting CLP (i.e., EL, AS, CS, and RS).
- This study quantitatively measured the WA of construction workers by adopting different scoring protocols. The RAI explains differences in WA between genders, while the AMI more precisely accounts for dissimilarities in WA on the basis of work experience.
- Newcomers are making a good start in their career development, whereas the most experienced workers are less enthusiastic than other groups about participating in simple tasks.
- Identified that WA plays an important role in improving CLP.
- The latent and potentially severe problems of labour management in the Vietnamese construction industry were identified: unsuccessful career development and the underutilisation of experienced workers.
- Three meaningful policy recommendations were put forward to solve the aforementioned problems and improve CLP: the effective organisation of crew members, the improvement of training and the improvement of site amenities.
- Developed and justified the AMI as an auxiliary to conventional indices; proposing five conditions necessary for optimal scoring in WA measurement and developing a motivation matrix that identifies and distinguishes the attributes of different groups.
- The most significant constraints on work motivation in construction projects were: (1) lack of professional training and advanced learning opportunities, (2) unskilled workforce, (3) lack of financial incentive

schemes, (4) payment delay, (5) poor work conditions, and (6) work dissatisfaction.

7.2. Implications

This study makes significant contributions to both the body of knowledge and the construction practices, in the Vietnamese construction industry particularly.

7.2.1. Theoretical Implications

This study expands and reinforces SDT knowledge by comprehensively illuminating leadership and psychological and motivational indicators in the construction context. Specifically, previous studies have determined the relationship between EL and BPNS, between BPNS and performance, and between BPNs and motivation, as well as the impact of motivation on performance or the impact of WE on performance. However, no study has integrated these variables to conduct explorations of the relationships among them. The current work filled this important gap by using the SDT perspective in developing and empirically investigating an integrated model to establish a comprehensive perspective of the leadership, psychological, and motivational factors affecting CLP. In addition, this study introduced and developed new scales for novel variables affecting CLP (i.e., EL, AS, CS, and RS), which has never been mentioned before in previous studies in the construction domain. Furthermore, selfish work is a novel factor that negatively contributes to CLP. This factor is the first discovered in the construction domain.

This study also expands existing knowledge on the phenomenon of interest in several respects. To begin with, the AMI was developed and justified as an auxiliary index that can be used to measure WA. In addition, five necessary conditions were proposed for the optimality of scoring protocols in WA measurement. Furthermore, the motivation matrix was developed to identify the attributes of each group. These contributions are beneficial to both academics and practitioners in their efforts to definitively and exhaustively identify or explore latent and deeply rooted problems, their causes and potential remedies.

7.2.2. Practical Implications

This study significantly contributes to construction workforce management, in the Vietnamese construction industry particularly, as follows.

To enhance productivity, one must determine and recognize the key factors that influence it. The author derived exhaustive knowledge to understand the psychological and motivational issues confronting construction workers. The results suggest that construction managers should improve CLP by reducing workers' perceptions of selfish work, as well as promoting the satisfaction of competence and relatedness needs and enhancing AM. These strategies encourage workers to dedicate all their energies to more efficiently and effectively engage with their designated tasks and pursue high productivity.

In addition, the author found that WA plays an important role in improving CLP. The results highlighted the need to pay more attention to the promotion of WA, competence satisfaction and relatedness satisfaction among workers. Furthermore, latent and potentially severe problems of labour management in Vietnam were identified: unsuccessful career development and the underutilisation of experienced workers. The study formulated three policy recommendations for solving the aforementioned problems and improving CLP: the effective organisation of work crew members, the improvement of training and the improvement of site amenities. These contributions significantly advance effective and sustainable labour management in Vietnam, with the possibility of being replicated in other countries facing similar problems.

The current study also contributes to construction practise by investigating the barriers to work motivation in construction projects through the risk mapping approach based on combining severity level and occurrence frequency of each factor which is considered in construction workforce motivation research. For the local Vietnamese construction practise, this study filled a gap by investigating both severity level and occurrence frequency of each barrier. This provided a better understanding for construction managers to minimize and eliminate the adverse effects of the most barriers to enhance work motivation and labour productivity and, consequently, increase the chance of implementing construction projects successfully.

7.3. Limitations and further works

Some limitations are worth noting to highlight directions for further research.

Firstly, it was carried out on a limited scale with 215 rebar and masonry workers in Vietnam, and of this sample, only 37 experienced workers engaged in simple tasks. This casts doubt on the representativeness of the sample in terms of worker and task categories. Researchers are encouraged to collect data from a wider range of participants with other types of designations and from other construction contexts. The author focused on the effects of leadership, psychological, and motivational aspects on worker productivity, but the influences of leadership, psychological, and motivational issues at multiple levels (e.g., team, project, and industry levels) on other project performance issues also play an important role. Cross-level research on projects/other performance variables may provide valuable results.

Secondly, no empirical corroboration was obtained as to which scoring protocol approach should be adopted to measure autonomy at work among trained and untrained workers. Such studies should prove very useful both from methodological and practical aspects.

Thirdly, this study explored the role and effectiveness of leadership in CLP improvement by introducing a new leadership concept (i.e., EL) in the construction domain. Unfortunately, however, the author could not determine an effective leadership style directed toward how to satisfy and enhance BPNS. Therefore, inquiring into relationships among other leadership styles (e.g., servant leadership, effective leadership, transformational leadership, leadership intelligence, or leader–member exchange), psychological factors, work motivation, and work performance in a holistic manner may open up new avenues for further studies.

Finally, to further validate the findings of this study, it is desirable to survey and confirm concrete career paths of workers through interviews. In addition, the influence of cultural aspects (e.g., project organizational culture, and local culture) should be considered with respect to improving CLP in future studies.

Publications

1. Nguyen Van Tam, Tsunemi Watanabe, Nguyen Luong Hai (2022), Importance of Autonomous Motivation in Construction Labour Productivity Improvement in Vietnam: A Self-Determination Theory Perspective, *Buildings*,12(6):763. https://doi.org/10.3390/buildings12060763 (IF:3.324)

2. Nguyen Van Tam, Tsunemi Watanabe, Nguyen Luong Hai (2022), Measuring Work Autonomy and Its Role in Enhancing Labour Productivity: The Case of the Vietnamese Construction Industry, *Buildings*, 12(9):1477. https://doi.org/10.3390/buildings12091477 (IF:3.324)

3. Nguyen Van Tam, Tsunemi Watanabe, Nguyen Luong Hai (2022), Factors Constraining Work Motivation in Construction Projects: A Case Study in Vietnam, In Proceedings of Creative Construction e-Conference, 9-11 July 2022, Budapest, Hungary.

References

1. Alaloul, W.S., et al., *Construction sector contribution to economic stability: Malaysian GDP distribution.* Sustainability, 2021. **13**(9): p. 5012.
2. Hillebrandt, P.M., *Economic theory and the construction industry*. 2000: Springer.
3. Alaloul, W.S., et al., *Investigating the impact of inflation on labour wages in Construction Industry of Malaysia.* Ain Shams Engineering Journal, 2021. **12**(2): p. 1575-1582.
4. Oladinrin, T., D. Ogunsemi, and I. Aje, *Role of construction sector in economic growth: Empirical evidence from Nigeria.* FUTY Journal of the Environment, 2012. **7**(1): p. 50-60.
5. Kenny, C., *Construction, corruption, and developing countries.* World Bank Policy Research Working Paper, 2007(4271).
6. Nguyen, T.N., *Foreign direct investment in real estate projects and macroeconomic instability.* ASEAN Economic Bulletin, 2011: p. 74-96.
7. Ngoc, N.M. *GDP contribution of the construction sector in Vietnam from 2015 to 2021*. 2022 October 23, 2022]; Available from: https://www.statista.com/statistics/1047711/vietnam-gdp-contribution-of-construction-sector/.
8. Van Tam, N., N.L. Huong, and N.B. Ngoc, *Factors affecting labour productivity of construction worker on construction site: A case of Hanoi.* Journal of Science and Technology in Civil Engineering (STCE)-NUCE, 2018. **12**(5): p. 127-138.
9. Vietnam, G.S.O.o., *Vietnamese Labor Productivity Report.* 2020.
10. PHAN, P.T., et al., *Factors Affecting the Work Motivation of the Construction Project Manager.* The Journal of Asian Finance, Economics, and Business, 2020. **7**(12): p. 1035-1043.
11. Gadde, L.-E. and A. Dubois, *Partnering in the construction industry—Problems and opportunities.* Journal of purchasing and supply management, 2010. **16**(4): p. 254-263.
12. Yap, J.B.H., I.N. Chow, and K. Shavarebi, *Criticality of construction industry problems in developing countries: Analyzing Malaysian projects.* Journal of Management in Engineering, 2019. **35**(5): p. 04019020.
13. Chen, Y., B. McCabe, and D. Hyatt, *Impact of individual resilience and safety climate on safety performance and psychological stress of construction workers: A case study of the Ontario construction industry.* Journal of safety research, 2017. **61**: p. 167-176.
14. Hashiguchi, N., et al., *The effects of psychological factors on perceptions of productivity in construction sites in Japan by worker age.* International journal of environmental research and public health, 2020. **17**(10): p. 3517.
15. Kisi, K.P., et al., *Optimal productivity in labor-intensive construction operations: Pilot study.* Journal of Construction Engineering and Management, 2017. **143**(3): p. 04016107.
16. Goodarzizad, P., E. Mohammadi Golafshani, and M. Arashpour, *Predicting the*

construction labour productivity using artificial neural network and grasshopper optimisation algorithm. International Journal of Construction Management, 2021: p. 1-17.
17. Małachowski, B. and P. Korytkowski, *Competence-based performance model of multi-skilled workers.* Computers & Industrial Engineering, 2016. **91**: p. 165-177.
18. Mahamid, I., *Principal factors impacting labor productivity of public construction projects in Palestine: contractors' perspective.* International Journal of Architecture, Engineering and Construction, 2013. **2**(3): p. 194-202.
19. El-Gohary, K.M. and R.F. Aziz, *Factors influencing construction labor productivity in Egypt.* Journal of management in engineering, 2014. **30**(1): p. 1-9.
20. Nasir, M.K. and B.H. Hadikusumo, *System dynamics model of contractual relationships between owner and contractor in construction projects.* Journal of Management in Engineering, 2019. **35**(1): p. 04018052.
21. Ayele, S. and A.R. Fayek, *A framework for total productivity measurement of industrial construction projects.* Canadian Journal of Civil Engineering, 2019. **46**(3): p. 195-206.
22. Jarkas, A.M. and C.G. Bitar, *Factors affecting construction labor productivity in Kuwait.* Journal of construction engineering and management, 2012. **138**(7): p. 811-820.
23. Shoar, S. and A. Banaitis, *Application of fuzzy fault tree analysis to identify factors influencing construction labor productivity: A high-rise building case study.* Journal of Civil Engineering and Management, 2018. **25**(1): p. 41-52.
24. Drucker, P., *Managing in the next society*. 2012: Routledge.
25. Dixit, S., et al., *Evolution of studies in construction productivity: A systematic literature review (2006–2017).* Ain Shams Engineering Journal, 2019. **10**(3): p. 555-564.
26. Abdul Kadir, M.R., et al., *Factors affecting construction labour productivity for Malaysian residential projects.* Structural Survey, 2005. **23**(1): p. 42-54.
27. Bin Seddeeq, A., et al., *Time and cost overrun in the Saudi Arabian oil and gas construction industry.* Buildings, 2019. **9**(2): p. 41.
28. Palikhe, S., S. Kim, and J.J. Kim, *Critical success factors and dynamic modeling of construction labour productivity.* International Journal of Civil Engineering, 2019. **17**(3): p. 427-442.
29. Jarkas, A.M. and M. Radosavljevic, *Motivational factors impacting the productivity of construction master craftsmen in Kuwait.* Journal of Management in Engineering, 2013. **29**(4): p. 446-454.
30. Hamza, M., et al., *Construction labour productivity: review of factors identified.* International Journal of Construction Management, 2019: p. 1-13.
31. Kazaz, A. and T. Acikara. *Comparison of Labor Productivity Perspectives of Project Managers and Craft Workers in Turkish Construction Industry*. 2015. Elsevier B.V.
32. ODClick, *Promoting work motivation and commitment of construction workforce (in Vietnamese)*. Accessed on 14 March, 2022; Available from: https://odclick.com/chuyen-san/ta%CC%A3o-do%CC%A3ng-lu%CC%A3c-

va-cam-ket-nhan-su%CC%A3-nganh-xay-du%CC%A3ng/, 2020.
33. Ha, T.H., *Proposing solutions to improve the labour quality in manufacturing building materials companies (in Vietnamese).* Construction and Urban Managers Institute Magazine, pp 6-10, 12/2021, 2021.
34. Ryan, R.M. and E.L. Deci, *Intrinsic and extrinsic motivations: Classic definitions and new directions.* Contemporary educational psychology, 2000. **25**(1): p. 54-67.
35. Lopes, H., S. Lagoa, and T. Calapez, *Work autonomy, work pressure, and job satisfaction: An analysis of European Union countries.* The Economic and Labour Relations Review, 2014. **25**(2): p. 306-326.
36. Ryan, R.M. and E.L. Deci, *Self-determination theory and the facilitation of intrinsic motivation, social development, and well-being.* American psychologist, 2000. **55**(1): p. 68.
37. Vansteenkiste, M., C.P. Niemiec, and B. Soenens, *The development of the five mini-theories of self-determination theory: An historical overview, emerging trends, and future directions*, in *The decade ahead: Theoretical perspectives on motivation and achievement*. 2010, Emerald Group Publishing Limited.
38. Tam, N.V., T. Watanabe, and N.L. Hai, *Importance of Autonomous Motivation in Construction Labor Productivity Improvement in Vietnam: A Self-Determination Theory Perspective.* Buildings, 2022. **12**(6): p. 763.
39. Tam, N.V., T. Watanabe, and N.L. Hai, *Measuring Work Autonomy and Its Role in Enhancing Labour Productivity: The Case of the Vietnamese Construction Industry.* Buildings, 2022. **12**(9): p. 1477.
40. Schaufeli, W., *Work engagement: What do we know and where do we go?* Romanian Journal of Applied Psychology, 2012. **14**(1): p. 3-10.
41. Schaufeli, W.B., *Engaging leadership in the job demands-resources model.* Career Development International, 2015.
42. Van Tuin, L., W.B. Schaufeli, and W. Van Rhenen, *The Satisfaction and Frustration of Basic Psychological Needs in Engaging Leadership.* Journal of Leadership Studies, 2020. **14**(2): p. 6-23.
43. Gagné, M. and E.L. Deci, *Self-determination theory and work motivation.* Journal of Organizational behavior, 2005. **26**(4): p. 331-362.
44. Deci, E.L. and R.M. Ryan, *The" what" and" why" of goal pursuits: Human needs and the self-determination of behavior.* Psychological inquiry, 2000. **11**(4): p. 227-268.
45. DeCharms, R., *Personal causation: The international affective determinations of behavior*. 1968: Acad. Press.
46. Van Petegem, S., et al., *On the association between adolescent autonomy and psychosocial functioning: examining decisional independence from a self-determination theory perspective.* Developmental psychology, 2012. **48**(1): p. 76.
47. Ryan, R.M. and J.H. Lynch, *Emotional autonomy versus detachment: Revisiting the vicissitudes of adolescence and young adulthood.* Child development, 1989: p. 340-356.
48. White, R.W., *Motivation reconsidered: The concept of competence.* Psychological review, 1959. **66**(5): p. 297.

49. Baumeister, R.F. and M.R. Leary, *The need to belong: desire for interpersonal attachments as a fundamental human motivation.* Psychological bulletin, 1995. **117**(3): p. 497.
50. Deci, E.L. and R.M. Ryan, *"Facilitating optimal motivation and psychological well-being across life's domains": Correction to Deci and Ryan (2008).* 2008.
51. Vallerand, R.J., *Deci and Ryan's self-determination theory: A view from the hierarchical model of intrinsic and extrinsic motivation.* Psychological inquiry, 2000. **11**(4): p. 312-318.
52. Ryan, R.M., *Psychological needs and the facilitation of integrative processes.* Journal of personality, 1995. **63**(3): p. 397-427.
53. McLachlan, S. and M.S. Hagger, *The influence of chronically accessible autonomous and controlling motives on physical activity within an extended theory of planned behavior.* Journal of Applied Social Psychology, 2011. **41**(2): p. 445-470.
54. Kahn, W.A., *Psychological conditions of personal engagement and disengagement at work.* Academy of management journal, 1990. **33**(4): p. 692-724.
55. Bakker, A.B. and E. Demerouti, *The crossover of work engagement between working couples: A closer look at the role of empathy.* Journal of Managerial Psychology, 2009.
56. Putra, E.D., S. Cho, and J. Liu, *Extrinsic and intrinsic motivation on work engagement in the hospitality industry: Test of motivation crowding theory.* Tourism and Hospitality Research, 2017. **17**(2): p. 228-241.
57. Karimi, S. and B. Sotoodeh, *The mediating role of intrinsic motivation in the relationship between basic psychological needs satisfaction and academic engagement in agriculture students.* Teaching in Higher Education, 2019.
58. Lamb, P.J., *INTRINSIC VS EXTRINSIC FACTORS OF MOTIVATION OF PSYCHOLOGISTS WHO HAVE EXPERIENCED BURNOUT AND A MAJOR ROLE CHANGE IN THEIR WORK.* 1985.
59. Thomas, K.W., *Intrinsic motivation at work: What really drives employee engagement*. 2009: Berrett-Koehler Publishers.
60. Chau, S. and C. Cheung, *Academic satisfaction with hospitality and tourism education in Macao: the influence of active learning, academic motivation, and student engagement.* Asia Pacific Journal of Education, 2018. **38**(4): p. 473-487.
61. Buil, I., S. Catalán, and E. Martínez, *Encouraging intrinsic motivation in management training: The use of business simulation games.* The International Journal of Management Education, 2019. **17**(2): p. 162-171.
62. Li, M., et al., *Value congruence and teachers' work engagement: The mediating role of autonomous and controlled motivation.* Personality and Individual Differences, 2015. **80**: p. 113-118.
63. Ryan, R.M. and E.L. Deci, *Promoting self-determined school engagement: Motivation, learning, and well-being.* 2009.
64. Meece, J.L., E.M. Anderman, and L.H. Anderman, *Classroom goal structure, student motivation, and academic achievement.* Annu. Rev. Psychol., 2006.

57: p. 487-503.
65. Coelli, T.J., et al., *An introduction to efficiency and productivity analysis*. 2005: Springer Science & Business Media.
66. Naoum, S.G., *Factors influencing labor productivity on construction sites.* International Journal of Productivity and Performance Management, 2016.
67. Durdyev, S. and J. Mbachu, *Key constraints to labour productivity in residential building projects: Evidence from Cambodia.* International Journal of Construction Management, 2018. **18**(5): p. 385-393.
68. Ghoddousi, P. and M.R. Hosseini, *A survey of the factors affecting the productivity of construction projects in Iran.* Technological and economic development of economy, 2012. **18**(1): p. 99-116.
69. Enshassi, A., et al., *Factors affecting labour productivity in building projects in the Gaza Strip.* Journal of civil engineering and management, 2007. **13**(4): p. 245-254.
70. Ministry, V.C., *Circular No.10/2019/TT-BXD: Promulgating Construction Norms, dated Dec.26, 2019*. 2019.
71. Vehovar, V., V. Toepoel, and S. Steinmetz, *Non-probability sampling.* The Sage handbook of survey methods, 2016: p. 329-345.
72. Assembly, V.N., *Youth Law No. 57/2020/QH14, dated June 16, 2020*. 2020.
73. Ministry, V.C., *Circular No.15/2019/TT-BXD: Providing instruction on the calculation of unit labor costs in construction sector, dated Dec.26, 2019. .* 2019.
74. Van den Broeck, A., et al., *Capturing autonomy, competence, and relatedness at work: Construction and initial validation of the Work-related Basic Need Satisfaction scale.* Journal of occupational and organizational psychology, 2010. **83**(4): p. 981-1002.
75. Van den Broeck, A., et al., *Explaining the relationships between job characteristics, burnout, and engagement: The role of basic psychological need satisfaction.* Work & stress, 2008. **22**(3): p. 277-294.
76. Johari, S. and K.N. Jha, *Impact of Work Motivation on Construction Labor Productivity.* Journal of Management in Engineering, 2020. **36**(5): p. 04020052.
77. Ferguson, R., et al., *Self-determination theory, social media and charitable causes: An in-depth analysis of autonomous motivation.* European journal of social psychology, 2015. **45**(3): p. 298-307.
78. Williams, G.G., et al., *Facilitating autonomous motivation for smoking cessation.* Health psychology, 2002. **21**(1): p. 40-50.
79. Rich, B.L., J.A. Lepine, and E.R. Crawford, *Job engagement: Antecedents and effects on job performance.* Academy of management journal, 2010. **53**(3): p. 617-635.
80. Eiselen, R., T. Uys, and N. Potgieter, *Analysing survey data using SPSS13: A workbook.* University of Johannesburg, 2005.
81. Bryman, A. and D. Cramer, *Quantitative data analysis with IBM SPSS 17, 18 and 19*. 2011: Routledge.
82. Jackson, J.E., *Principal components and factor analysis: part I—principal components.* Journal of Quality Technology, 1980. **12**(4): p. 201-213.

83. Hair, J.F., et al., *Multivariate data analysis*. Vol. 5. 1998: Prentice hall Upper Saddle River, NJ.
84. Mullan, E. and D. Markland, *Variations in self-determination across the stages of change for exercise in adults.* Motivation and emotion, 1997. **21**(4): p. 349-362.
85. Markland, D. and D.K. Ingledew, *The relationships between body mass and body image and relative autonomy for exercise among adolescent males and females.* Psychology of Sport and Exercise, 2007. **8**(5): p. 836-853.
86. Vallerand, R.J., L.G. Pelletier, and R. Koestner, *Reflections on self-determination theory.* Canadian Psychology/Psychologie Canadienne, 2008. **49**(3): p. 257.
87. Wilson, P.M., et al., *On the nature and function of scoring protocols used in exercise motivation research: An empirical study of the behavioral regulation in exercise questionnaire.* Psychology of Sport and Exercise, 2012. **13**(5): p. 614-622.
88. Fornell, C. and D.F. Larcker, *Evaluating structural equation models with unobservable variables and measurement error.* Journal of marketing research, 1981. **18**(1): p. 39-50.
89. Hair Jr, J.F., et al., *A primer on partial least squares structural equation modeling (PLS-SEM)*. 2016: Sage publications.
90. Kline, R.B., *Principles and practice of structural equation modeling*. 2015: Guilford publications.
91. Van Tam, N., et al., *Impact of BIM-related factors affecting construction project performance.* International Journal of Building Pathology and Adaptation, 2021.
92. Durdyev, S., S. Ismail, and N. Kandymov, *Structural equation model of the factors affecting construction labor productivity.* Journal of Construction Engineering and Management, 2018. **144**(4): p. 04018007.
93. Field, A., *Discovering statistics using SPSS*. 2009: Sage, London.
94. Cho, K., T. Hong, and C. Hyun, *Effect of project characteristics on project performance in construction projects based on structural equation model.* Expert Systems with Applications, 2009. **36**(7): p. 10461-10470.
95. Thorndike, R.M., *Book review: psychometric theory by Jum Nunnally and Ira Bernstein New York: McGraw-hill, 1994, xxiv+ 752 pp.* Applied Psychological Measurement, 1995. **19**(3): p. 303-305.
96. Hair Jr, J.F., et al., *Partial least squares structural equation modeling (PLS-SEM): An emerging tool in business research.* European business review, 2014.
97. Byrne, B.M., *Structural equation modeling with Mplus: Basic concepts, applications, and programming*. 2013: routledge.
98. Hu, L.t. and P.M. Bentler, *Cutoff criteria for fit indexes in covariance structure analysis: Conventional criteria versus new alternatives.* Structural equation modeling: a multidisciplinary journal, 1999. **6**(1): p. 1-55.
99. Bagozzi, R.P. and Y. Yi, *On the evaluation of structural equation models.* Journal of the academy of marketing science, 1988. **16**(1): p. 74-94.
100. Byrne, B.M., *Structural equation modeling with AMOS: basic concepts, applications, and programming (multivariate applications series).* New York:

Taylor & Francis Group, 2010. **396**: p. 7384.
101. Aho, K., D. Derryberry, and T. Peterson, *Model selection for ecologists: the worldviews of AIC and BIC.* Ecology, 2014. **95**(3): p. 631-636.
102. Tabachnick, B.G., L.S. Fidell, and J.B. Ullman, *Using multivariate statistics*. Vol. 5. 2007: Pearson Boston, MA.
103. Abusafiya, H. and S. Suliman, *Causes and effects of cost overrun on construction project in Bahrain: Part I (ranking of cost overrun factors and risk mapping).* Modern Applied Science, 2017. **11**(7): p. 20.
104. Gunduz, M. and A. Abu-Hijleh, *Assessment of Human Productivity Drivers for Construction Labor through Importance Rating and Risk Mapping.* Sustainability, 2020. **12**(20): p. 8614.
105. Mahamid, I., *Risk matrix for factors affecting time delay in road construction projects: owners' perspective.* Engineering, Construction and Architectural Management, 2011.
106. Sandbhor, S. and R. Botre, *Applying total interpretive structural modeling to study factors affecting construction labour productivity.* Australasian Journal of Construction Economics and Building, 2014. **14**(1): p. 20-31.
107. Khan, A., M. Umer, and S.M. Khan, *Effect of basic motivational factors on construction workforce productivity in Pakistan.* International Conference on Structural Engineering Construction and Management, 2011.
108. Kazaz, A., E. Manisali, and S. Ulubeyli, *Effect of basic motivational factors on construction workforce productivity in Turkey.* Journal of civil engineering and management, 2008. **14**(2): p. 95-106.
109. Al-Abbadi, G.M. and G. Agyekum-Mensah, *The effects of motivational factors on construction professionals productivity in Jordan.* International Journal of Construction Management, 2019.
110. Momade, M.H. and M.R. Hainin, *Identifying motivational and demotivational productivity factors in Qatar construction projects.* Eng Technol Appl Sci Res, 2019. **9**(2): p. 3945-3948.
111. Lee, M.Y. and A.C. Edmondson, *Self-managing organizations: Exploring the limits of less-hierarchical organizing.* Research in organizational behavior, 2017. **37**: p. 35-58.
112. Robles, G., et al., *Labor productivity in the construction industry-factors influencing the Spanish construction labor productivity.* International Journal of Civil, Environmental, Structural, Construction and Architectural Engineering, 2014. **8**(10): p. 1021-1030.
113. Ailabouni, N., K. Gidado, and N. Painting. *Factors affecting employee productivity in the UAE construction industry*. in *25th Annual ARCOM Conference, Nottingham, UK*. 2009.
114. Ryan, R.M. and E.L. Deci, *Self-determination theory: Basic psychological needs in motivation, development, and wellness*. 2017: Guilford Publications.
115. Deci, E.L., A.H. Olafsen, and R.M. Ryan, *Self-determination theory in work organizations: The state of a science.* Annual Review of Organizational Psychology and Organizational Behavior, 2017. **4**: p. 19-43.
116. Baard, P.P., E.L. Deci, and R.M. Ryan, *Intrinsic need satisfaction: a motivational basis of performance and weil-being in two work settings 1.*

Journal of applied social psychology, 2004. **34**(10): p. 2045-2068.
117. van Tuin, L., et al., *Business results and well-being: An engaging leadership intervention study.* International Journal of Environmental Research and Public Health, 2020. **17**(12): p. 4515.
118. Deci, E.L. and R.M. Ryan, *The support of autonomy and the control of behavior.* Journal of personality and social psychology, 1987. **53**(6): p. 1024.
119. Humphrey, S.E., J.D. Nahrgang, and F.P. Morgeson, *Integrating motivational, social, and contextual work design features: a meta-analytic summary and theoretical extension of the work design literature.* Journal of applied psychology, 2007. **92**(5): p. 1332.
120. Reeve, J., *Understanding motivation and emotion*. 2014: John Wiley & Sons.
121. Deci, E.L., R.M. Ryan, and G.C. Williams, *Need satisfaction and the self-regulation of learning.* Learning and individual differences, 1996. **8**(3): p. 165-183.
122. Chiniara, M. and K. Bentein, *Linking servant leadership to individual performance: Differentiating the mediating role of autonomy, competence and relatedness need satisfaction.* The Leadership Quarterly, 2016. **27**(1): p. 124-141.
123. Karau, S.J. and K.D. Williams, *Social loafing: A meta-analytic review and theoretical integration.* Journal of personality and social psychology, 1993. **65**(4): p. 681.
124. Brien, M., C. Hass, and A. Savoie, *Psychological health as a mediator between need satisfaction at work and teachers' self-perceptions of performance.* Canadian Journal of Behavioural Science/Revue canadienne des sciences du comportement, 2012. **44**(4): p. 288.
125. Greguras, G.J. and J.M. Diefendorff, *Different fits satisfy different needs: Linking person-environment fit to employee commitment and performance using self-determination theory.* Journal of applied psychology, 2009. **94**(2): p. 465.
126. Kluger, A.N. and A. DeNisi, *The effects of feedback interventions on performance: A historical review, a meta-analysis, and a preliminary feedback intervention theory.* Psychological bulletin, 1996. **119**(2): p. 254.
127. Fisher, C.D., *The effects of personal control, competence, and extrinsic reward systems on intrinsic motivation.* Organizational behavior and human performance, 1978. **21**(3): p. 273-288.
128. Snyder, R.A., R.R. Williams, and J.F. Cashman, *Age, tenure, and work perceptions as predictors of reactions to performance feedback.* The Journal of psychology, 1984. **116**(1): p. 11-21.
129. Hewage, K.N., *Construction productivity improvement by worker motivation and IT based communication*, in *Schulich School of Engineering* 2007, The University of Calgary: Calgary, Canada.
130. Doloi, H., *Twinning motivation, productivity and management strategy in construction projects.* Engineering Management Journal, 2007. **19**(3): p. 30-40.
131. Al-Abbadi, G.M.d. and G. Agyekum-Mensah, *The effects of motivational factors on construction professionals productivity in Jordan.* International

Journal of Construction Management, 2019: p. 1-12.
132. Olomolaiye, P.O., *An evaluation of the relationships between bricklayers' motivation and productivity.* Construction management and economics, 1990. **8**(3): p. 301-313.
133. Ghoddousi, P., et al., *Labour productivity in Iranian construction projects.* International Journal of Productivity and Performance Management, 2015.
134. Nasirzadeh, F. and P. Nojedehi, *Dynamic modeling of labor productivity in construction projects.* International journal of project management, 2013. **31**(6): p. 903-911.
135. Aghayeva, K. and B. Ślusarczyk, *Analytic hierarchy of motivating and demotivating factors affecting labor productivity in the construction industry: the case of Azerbaijan.* Sustainability, 2019. **11**(21): p. 5975.
136. Lingard, H. and V. Francis, *Does a supportive work environment moderate the relationship between work-family conflict and burnout among construction professionals?* Construction Management and Economics, 2006. **24**(2): p. 185-196.
137. Farmer, S.M., L. Van Dyne, and D. Kamdar, *The contextualized self: How team–member exchange leads to coworker identification and helping OCB.* Journal of Applied Psychology, 2015. **100**(2): p. 583.
138. Ilies, R., J.D. Nahrgang, and F.P. Morgeson, *Leader-member exchange and citizenship behaviors: A meta-analysis.* Journal of applied psychology, 2007. **92**(1): p. 269.
139. Moss, E. and D. St-Laurent, *Attachment at school age and academic performance.* Developmental psychology, 2001. **37**(6): p. 863.
140. Porath, C.L. and A. Erez, *Does rudeness really matter? The effects of rudeness on task performance and helpfulness.* Academy of Management Journal, 2007. **50**(5): p. 1181-1197.
141. Marcus, R.F. and J. Sanders-Reio, *The influence of attachment on school completion.* School Psychology Quarterly, 2001. **16**(4): p. 427.
142. Cerasoli, C.P. and M.T. Ford, *Intrinsic motivation, performance, and the mediating role of mastery goal orientation: A test of self-determination theory.* The Journal of psychology, 2014. **148**(3): p. 267-286.
143. Kirkland, R.A., et al., *Basic psychological needs satisfaction, motivation, and exercise in older adults.* Activities, adaptation & aging, 2011. **35**(3): p. 181-196.
144. Olafsen, A.H., E.L. Deci, and H. Halvari, *Basic psychological needs and work motivation: A longitudinal test of directionality.* Motivation and Emotion, 2018. **42**(2): p. 178-189.
145. Deci, E.L. and R.M. Ryan, *The empirical exploration of intrinsic motivational processes*, in *Advances in experimental social psychology*. 1980, Elsevier. p. 39-80.
146. Wang, C.J., et al., *Competence, autonomy, and relatedness in the classroom: understanding students' motivational processes using the self-determination theory.* Heliyon, 2019. **5**(7): p. e01983.
147. Carreira, J.M., *Motivational orienations and psychological needs in EFL learning among elementary school students in Japan.* System, 2012. **40**(2): p.

191-202.
148. Jowett, G.E., et al., *Perfectionism and junior athlete burnout: The mediating role of autonomous and controlled motivation.* Sport, Exercise, and Performance Psychology, 2013. **2**(1): p. 48.
149. Haivas, S., J. Hofmans, and R. Pepermans, *Volunteer engagement and intention to quit from a self-determination theory perspective.* Journal of Applied Social Psychology, 2013. **43**(9): p. 1869-1880.
150. Stoeber, J., C.R. Davis, and J. Townley, *Perfectionism and workaholism in employees: The role of work motivation.* Personality and Individual Differences, 2013. **55**(7): p. 733-738.
151. Ariely, D., et al., *Large stakes and big mistakes.* The Review of Economic Studies, 2009. **76**(2): p. 451-469.
152. Karatepe, O.M., *High-performance work practices and hotel employee performance: The mediation of work engagement.* International Journal of Hospitality Management, 2013. **32**: p. 132-140.
153. van Beek, I., et al., *For fun, love, or money: What drives workaholic, engaged, and burned-out employees at work?* Applied Psychology, 2012. **61**(1): p. 30-55.
154. Demerouti, E., et al., *Employee well-being and job performance: Where we stand and where we should go.* Occupational health psychology: European perspectives on research, education and practice, 2006. **1**: p. 83-111.
155. Bakker, A.B. and E. Demerouti, *Towards a model of work engagement.* Career development international, 2008.
156. Salanova, M., S. Agut, and J.M. Peiró, *Linking organizational resources and work engagement to employee performance and customer loyalty: the mediation of service climate.* Journal of applied Psychology, 2005. **90**(6): p. 1217.
157. Hough, L.M. and M.D. Dunnette, *Handbook of industrial and organizational psychology*. 1990: Consulting Psychologists Press.
158. Kahn, W.A., *To be fully there: Psychological presence at work.* Human relations, 1992. **45**(4): p. 321-349.
159. Katz, D. and R.L. Kahn, *The social psychology of organizations*. Vol. 2. 1978: Wiley New York.
160. Brown, S.P. and T.W. Leigh, *A new look at psychological climate and its relationship to job involvement, effort, and performance.* Journal of applied psychology, 1996. **81**(4): p. 358.
161. Weick, K.E. and K.H. Roberts, *Collective mind in organizations: Heedful interrelating on flight decks.* Administrative science quarterly, 1993: p. 357-381.
162. Ashforth, B.E. and R.H. Humphrey, *Emotion in the workplace: A reappraisal.* Human relations, 1995. **48**(2): p. 97-125.
163. Johari, S. and K.N. Jha, *Interrelationship among Belief, Intention, Attitude, Behavior, and Performance of Construction Workers.* Journal of Management in Engineering, 2020. **36**(6): p. 04020081.
164. Taris, T.W., I. van Beek, and W.B. Schaufeli, *The motivational make-up of workaholism and work engagement: A longitudinal study on need satisfaction,*

motivation, and heavy work investment. Frontiers in Psychology, 2020. **11**: p. 1419.
165. Bollen, K.A. and J.S. Long, *Testing structural equation models*. Vol. 154. 1993: Sage.
166. Chen, B., et al., *Basic psychological need satisfaction, need frustration, and need strength across four cultures.* Motivation and emotion, 2015. **39**(2): p. 216-236.
167. Lai, F.-Y., et al., *Transformational leadership and job performance: the mediating role of work engagement.* SAGE Open, 2020. **10**(1): p. 2158244019899085.
168. Rahmadani, V.G., et al., *Basic psychological need satisfaction mediates the relationship between engaging leadership and work engagement: A cross-national study.* Human Resource Development Quarterly, 2019. **30**(4): p. 453-471.
169. Molenaar, K., S. Washington, and J. Diekmann, *Structural equation model of construction contract dispute potential.* Journal of Construction Engineering and Management, 2000. **126**(4): p. 268-277.
170. Ohueri, C.C., et al., *Labour productivity motivation framework for Iskandar Malaysia.* Built Environment Project and Asset Management, 2018.
171. TheWorldBank. *The World Bank In Vietnam*. 2021 [cited 2021 October 8, 2021]; Available from: https://www.worldbank.org/en/country/vietnam/overview#1.
172. Maslow, A.H., *A theory of human motivation.* Psychological review, 1943. **50**(4): p. 370.
173. Maslow, A.H., *Motivation and personality (3rd ed.)*. 1987: Delhi, India: Pearson Education.
174. Bakker, A.B., *Building engagement in the workplace.* The peak performing organization, 2009. **50**.
175. Dysvik, A. and B. Kuvaas, *Intrinsic motivation as a moderator on the relationship between perceived job autonomy and work performance.* European journal of work and organizational psychology, 2011. **20**(3): p. 367-387.
176. Kim, T.Y., et al., *Emotional competence and work performance: The mediating effect of proactivity and the moderating effect of job autonomy.* Journal of Organizational Behavior: The International Journal of Industrial, Occupational and Organizational Psychology and Behavior, 2009. **30**(7): p. 983-1000.
177. Liu, D., X.-P. Chen, and X. Yao, *From autonomy to creativity: a multilevel investigation of the mediating role of harmonious passion.* Journal of Applied Psychology, 2011. **96**(2): p. 294.
178. Wichmann, S.S., *Self-determination theory: The importance of autonomy to well-being across cultures.* The Journal of Humanistic Counseling, 2011. **50**(1): p. 16-26.
179. Saragih, S., *The effects of job autonomy on work outcomes: Self efficacy as an intervening variable.* International Research Journal of Business Studies, 2015. **4**(3).

180. Langfred, C.W. and N.A. Moye, *Effects of task autonomy on performance: an extended model considering motivational, informational, and structural mechanisms.* Journal of applied psychology, 2004. **89**(6): p. 934.
181. Bandura, A., *Social cognitive theory of self-regulation.* Organizational behavior and human decision processes, 1991. **50**(2): p. 248-287.
182. Guttman, L., *A new approach to factor analysis: The radex.* Mathematical thinking in the social sciences 1954: p. 258-348.
183. Kim, H.-Y., *Analysis of variance (ANOVA) comparing means of more than two groups.* Restorative dentistry & endodontics, 2014. **39**(1): p. 74-77.
184. Hiyassat, M.A., M.A. Hiyari, and G.J. Sweis, *Factors affecting construction labour productivity: a case study of Jordan.* International Journal of Construction Management, 2016. **16**(2): p. 138-149.
185. CareerExplorer. *What does a construction worker do?* 2022 [cited 2022 April 26]; Available from: https://www.careerexplorer.com/careers/construction-worker/.
186. Johari, S. and K. Jha, *Development and implementation of on-the-job training system for construction workers*, in *Urbanization Challenges in Emerging Economies: Energy and Water Infrastructure; Transportation Infrastructure; and Planning and Financing*. 2018, American Society of Civil Engineers Reston, VA. p. 405-416.
187. Gupta, M., et al., *Site amenities and workers' welfare factors affecting workforce productivity in Indian construction projects.* Journal of Construction Engineering and Management, 2018. **144**(11): p. 04018101.
188. Kaming, P.F., et al., *Factors influencing construction time and cost overruns on high-rise projects in Indonesia.* Construction Management & Economics, 1997. **15**(1): p. 83-94.
189. Alaghbari, W., A.A. Al-Sakkaf, and B. Sultan, *Factors affecting construction labour productivity in Yemen.* International Journal of Construction Management, 2019. **19**(1): p. 79-91.
190. Tammy, N.J., et al., *Evaluation of Human Factors Influencing Labor Productivity in Construction Project*, in *Lecture Notes in Civil Engineering*. 2020, Springer. p. 1549-1561.
191. Fagbenle, O.I., A.O. Ogunde, and J.D. Owolabi, *Factors affecting the performance of labour in Nigerian construction sites.* Mediterranean journal of social sciences, 2011. **2**(2): p. 251-251.
192. Tam, V.W. and I.W. Fung, *Behavior, attitude, and perception toward safety culture from mandatory safety training course.* Journal of Professional Issues in Engineering Education and Practice, 2012. **138**(3): p. 207-213.
193. Johari, S. and K. Neeraj Jha, *Framework for identifying competencies of construction workers.* Journal of Construction Engineering and Management, 2021. **147**(5): p. 04021034.
194. Marín, L.S. and C. Roelofs, *Promoting construction supervisors' safety-efficacy to improve safety climate: Training intervention trial.* Journal of Construction Engineering and Management, 2017. **143**(8): p. 04017037.
195. Fang, D., C. Zhao, and M. Zhang, *A cognitive model of construction workers' unsafe behaviors.* Journal of Construction Engineering and Management,

2016. **142**(9): p. 04016039.
196. Johari, S. and K.N. Jha, *Impact of Work Motivation on Construction Labor Productivity.* Journal of Management in Engineering, 2020. **36**(5).
197. Jarkas, A.M., M. Radosavljevic, and L. Wuyi, *Prominent demotivational factors influencing the productivity of construction project managers in Qatar.* International Journal of Productivity and Performance Management, 2014.
198. Johari, S. and K.N. Jha, *How the Aptitude of Workers Affects Construction Labor Productivity.* Journal of Management in Engineering, 2020. **36**(5).
199. Hasan, A., et al., *Factors affecting construction productivity: a 30 year systematic review.* Engineering, Construction and Architectural Management, 2018.
200. Ng, S.T., et al., *Demotivating factors influencing the productivity of civil engineering projects.* International journal of project Management, 2004. **22**(2): p. 139-146.
201. Jarkas, A.M., M. Radosavljevic, and L. Wuyi, *Prominent demotivational factors influencing the productivity of construction project managers in Qatar.* International Journal of Productivity and Performance Management, 2014. **63**(8): p. 1070-1090.
202. Funso, A., L. Sammy, and M. Gerryshom, *Application of motivation in Nigeria construction industry: Factor analysis approach.* International Journal of Economics and Finance, 2016. **8**(5): p. 271-276.
203. Sweis, N.J., et al., *Demotivating factors influencing productivity in Jordanian residential construction projects.* International Journal of Productivity and Quality Management, 2017. **20**(2): p. 154-168.
204. Shroff, R.P. and S. Sridhar, *Study of motivators and demotivators affecting the performance of employees in the construction industry–an exploratory study.* International Journal of Construction Management, 2011. **11**(3): p. 49-66.
205. Chigara, B. and T. Moyo, *Factors affecting labor productivity on building projects in Zimbabwe.* International Journal of Architecture, Engineering and Construction, 2014. **3**(1): p. 57-65.
206. Olomolaiye, P., A. Jayawardane, and F. Harris, *Construction productivity management*. 1998.
207. Mbachu, J. and S. Taylor, *Contractual risks in the New Zealand construction industry: Analysis and mitigation measures.* International Journal of Construction Supply Chain, 2014. **4**(2): p. 22-33.
208. Vaske, J.J., J. Beaman, and C.C. Sponarski, *Rethinking internal consistency in Cronbach's alpha.* Leisure Sciences, 2017. **39**(2): p. 163-173.
209. Joseph, F., et al., *Multivariate data analysis*. 2010: Pearson Prentice Hall.
210. Zakeri, M., et al., *Factors affecting the motivation of Iranian construction operatives.* Building and Environment, 1997. **32**(2): p. 161-166.
211. Mahamid, I., *Contractors perspective toward factors affecting labor productivity in building construction.* Engineering, Construction and Architectural Management, 2013.
212. Sekhar, C., M. Patwardhan, and R.K. Singh, *A literature review on motivation.* Global business perspectives, 2013. **1**(4): p. 471-487.
213. Dwivedula, R. and C.N. Bredillet, *Profiling work motivation of project*

workers. International Journal of Project Management, 2010. **28**(2): p. 158-165.
214. PORTIA, L. and A. CLINTON, *Job Dissatisfaction Influence on Construction Employee Absenteeism and Turnover.* Integrated Solutions for Infrastructure Development, 2016: p. 1-6.
215. M. Reza, H., C. Nicholas, and Z. George, *Investigating the Factors Associated with Job Satisfaction of Construction Workers in South Australia.* Construction Economics and Building, 2014. **14**(3): p. 1-17.

Appendices

QUESTIONNAIRE SURVEY
For construction rebar workers

Dear Sir/Madam,

I am Nguyen Van Tam, a Ph.D. student at Kochi University of Technology, Japan.

This questionnaire aims to identify and examine engaging leadership, psychological and motivational factors regarding improving the labor productivity of construction workers on sites. I hope from you is a frank and impartial opinion based on your viewpoint and practical experience. Your personal information and all the answers will remain confidential; all the information will be analyzed for research purposes only.

Please choose the most recently completed (or implementing) construction project on which you were personally involved and provide appropriate answers to the questions/or descriptions below:

A- Demographic information

1. Name:……Phone:……..……
2. Gender: ☐Male ☐ Female
3. Age (years): ……
4. Education level:
   ☐ No education ☐ Primary school
   ☐ Secondary school ☐ High school and above
5. Your training experience in the construction industry is (years): ……
6. Your experience in the construction industry is (years): …….
7. Marital status
   ☐ Single ☐ Married
8. Weight:…….kg Height:…….cm
9. Your income average per month from construction works is: ……(VND mil.)

B- Survey on engaging leadership, psychological and motivational factors affecting construction workers' productivity on sites

Please answer the following statements based on your viewpoint and practical experience

(1- Strongly Disagree; 2- Disagree; 3 – Neutral; 4 – Agree; 5 - Strongly Agree)

Code	Construct items	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
	Engaging Leadership					
	Strengthening					
EL1	My supervisors encouraged me to develop knowledge and skills as much as possible on my tasks	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
EL2	My supervisors encouraged me to develop my talents as much as possible on my tasks	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
EL3	My supervisors delegate specific tasks and responsibilities to each member of my team	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
EL4	My supervisors encouraged me to use my own strengths on tasks	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
EL5	My supervisors encouraged me to overcome the challenging tasks	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
	Connecting					
EL6	My supervisors encouraged collaboration among team members on sites	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
EL7	My supervisors encourage support among team members on our tasks	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
EL8	My supervisors promote team connection by creating a comfortable working atmosphere on our tasks	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
	Empowering					
EL9	My supervisors give me enough freedom and responsibility to complete my tasks	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
EL10	My supervisors listen to how I would like to do things in improving my work efficiency	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
EL11	My supervisors appreciated my contribution to my team on tasks	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
EL12	My supervisors encouraged me to ask questions and give my own opinions	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
	Autonomy Satisfaction					
AS1	I feel that my decisions reflect what I really want	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
AS2	I feel my choices express who I really am	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐

Code	Construct items	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
AS3	I feel I have been doing what really interests	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
AS4	I feel a sense of choice in the tasks I undertake	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
AS5	I feel freedom in the tasks I undertake	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
	Competence Satisfaction					
CS1	I feel competent to achieve my goals and company goals	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
CS2	I feel I can successfully complete difficult or challenging tasks	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
CS3	I feel capable of what I do on site	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
CS4	I feel confident that I can do things well	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
CS5	I feel effective in what I do on site	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
CS6	I feel a have sufficient work-related skills or knowledge on site	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
	Relatedness Satisfaction					
RS1	I feel close and connected with other people on site (e.g., supervisor, teammates)	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
RS2	I feel connected with people who care for me, and for whom I care (e.g., family, supervisor, teammates)	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
RS3	I experience a happy feeling with the people I spend time with	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
RS4	I feel that the people I care about also care about me	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
RS5	I experience a comfortable feeling with the people I spend time with	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
RS6	My supervisors and teammates help me when I need help.	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
Why do you or would you put effort into your current job?						
	Amotivation					
Amot1	I don't know why I am doing this job; it's pointless work	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
Amot2	I do little because I don't think this work is worth putting try into	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
Amot3	I don't because I really feel that I'm wasting my time at work	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
Amot4	But I do not have a good reason for work	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
	Intrinsic motivation *(Autonomous motivation)*					
Intri1	Because it is really important for me	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐

Code	Construct items	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
Intri2	Because what I do in my job is exciting	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
Intri3	Because I have fun doing my job	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
Intri4	Because I have a chance to learn new things/new skills	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
Intri5	Because I would feel there are many benefits to do it	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
Intri6	Because I enjoy finding valuable solutions from various teammates	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
Intri7	Because I interested in challenging tasks	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
Intri8	Because I will be delegated more authority	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
	Integrated regulation *(Autonomous motivation)*					
Inte1	Because it is really a part of who I am	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
Inte2	Because it is very meaningful for me	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
Inte3	Because it is something, I value deeply	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
Inte4	Because it is in line with my personal goals	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
Inte5	Because putting try into this job aligns with my personal values	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
	Identified regulation *(Autonomous motivation)*					
Iden1	Because I personally consider it important to put try into this job	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
Iden2	Because I try to improve my skills in my works	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
Iden3	Because putting try into this job holds personal significance for me	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
Iden4	Because I will be delegated authority or will be participated in decision-making	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
Iden5	Because I receive appropriate feedback from others (e.g., supervisor, teammates)	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
	Introjected regulation *(Controlled motivation)*					
Intro1	Because I have to prove to myself that I can	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
Intro2	Because I would feel bad about myself if I did not	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
Intro3	Because it makes me feel proud of myself	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
Intro4	Because otherwise, I would feel ashamed of myself	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐

Code	Construct items	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
Intro5	Because it bothers me when I do not	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
Intro6	Because otherwise, I would feel bad about myself	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
	External regulation *(Controlled motivation)*					
Exter1	Because I work to get others' approval (e.g., supervisor, teammates)	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
Exter2	Because others will respect me more (e.g., supervisor, teammates, family)	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
Exter3	Because I try to avoid being criticized by others (e.g., supervisor, teammates)	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
Exter4	Because that is what I am supposed to do	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
Exter5	Because others would not be disappointed in me (e.g., supervisor, teammates, family)	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
Exter6	Because I could lose my job if I don't put enough try into it	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
Exter7	Because I will be rewarded financially only if I put enough try into my job	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
Exter8	Because I work at safety and health conditions	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
Exter9	Because I received good support from others in my work (e.g., supervisor, teammates)	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
	Work Engagement					
	Physical engagement					
WE1	I do my best because I consider the interests of the company to be my interest	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
WE2	I always try improving my labor productivity by fully exercise my strengths in my tasks	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
WE3	I work extra hours to make work procedures smooth and complete my work before the deadline	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
WE4	I agree with most of the company's policies toward employees	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
WE5	I always make an extra try for the company by increasing the work efficiency of my team	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
WE6	I engage in extra activities to build good relationships with others (e.g., supervisor, teammates)					

Code	Construct items	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
WE7	I participate in training courses in order to improve my knowledge and skills	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
WE8	I always follow the work process in order to ensure my work efficiency	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
WE9	I always follow the rules/regulations in workplace in order to ensure my work efficiency	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
WE10	I try to learn new things in order to accumulate my knowledge and skills	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
	Cognitive engagement					
WE11	I feel my work is everything to me; hence, I always try improving my labor productivity	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
WE12	I am willing to work extra hours to make work procedures smooth and complete my work before the deadline	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
WE13	I am willing to make an extra try for the company by increasing the work efficiency of my group	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
WE14	I am willing to engage in extra activities to build good relationships with others (e.g., supervisor, teammates)	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
WE15	I am willing to participate in training courses in order to improve my knowledge and skills	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
WE16	I am willing to follow the work process in order to ensure my work efficiency	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
WE17	I am willing to follow the rules/regulations in workplace in order to ensure my work efficiency	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
WE18	I am willing to learn new things in order to accumulate my knowledge and skills	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
	Emotional engagement					
WE19	I am enthusiastic about my tasks on site	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
WE20	I feel energetic at my tasks on site	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
WE21	I am interested in my tasks on site	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
WE22	I am happy to accept any tasks assigned by the management team, as long as they fall within a reasonable scope	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
WE23	I feel positive about my tasks on site	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
WE24	I am excited about my tasks on site	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐

B- Measurement of workers' productivity in several main rebar works on sites (for civil buildings)

Based on your practical experience construction in civil buildings, please estimate your productivity in the following construction tasks

These figures are estimated for labor productivity of per worker working per shift (8 hours) on-site.

Manufacturing and arranging of rebar tasks (only for rebar worker)

LP1. Manufacturing of rebar *(cutting, bending, and shaping according to drawing's designation)*

[1]☐ < 150 kg [2]☐ 150 – 170 kg [3]☐ 171 – 190 kg

[4]☐ 191 – 210 kg [5]☐ > 210 kg

LP2. Installing and arranging of rebar for foundation

[1]☐ < 130 kg [2]☐ 130 – 150 kg [3]☐ 151 – 170 kg

[4]☐ 171 – 190 kg [5]☐ > 190 kg

LP3. Installing and arranging of rebar for column

[1]☐ < 80 kg [2]☐ 80 – 100 kg [3]☐ 101 – 120 kg

[4]☐ 121 – 140 kg [5]☐ >140kg

LP4. Installing and arranging of steel for beam

[1]☐ < 70 kg [2]☐ 70 – 90 kg [3]☐ 91 – 110 kg

[4]☐ 111 – 130 kg [5]☐ >130 kg

LP5. Installing and arranging of steel floor

[1]☐ < 60 kg [2]☐ 60 – 75 kg [3]☐ 76 – 90 kg

[4]☐ 91 – 105 kg [5]☐ >105 kg

C- Survey on factors constraining work motivation cause of decreasing workers' productivity on sites

Please assess the level of each factor constraining work motivation cause of decreasing workers' productivity on sites in the following questions:

1. How much its severity level decrease workers' productivity?

(No severity; 2- Moderate severity; 3 – Strong severity; 4 – Very strong severity; 5 – Extreme severity)

2. How often it is considered on sites? (probability of occurrence)

(1-Unlikely to happen, 2-May happen, 3-Likely to happen, 4-Very likely to happen, 5-Certain to happen)

Code	Constraint	Severity level					Probability of occurrence				
		No severity	Moderate severity	Strong severity	Very strong severity	Extreme severity	Unlikely to happen	May happen	Likely to happen	Very likely to happen	Certain to happen
C1	Bad treatment by the supervisors	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
C2	Changing on workmates	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
C3	Delay in responding to Requests for Information	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
C4	Delay payment	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
C5	Health personal problems	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
C6	Inadequate managerial competence	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
C7	Inappropriate evaluation and feedback	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
C8	Inclement weather	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
C9	Incompetent teammates	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
C10	Laborers' disloyalty	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
C11	Lack of cooperation	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
C12	Lack of discipline on site	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
C13	Lack of financial incentive schemes	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
C14	Lack of participation in decision making	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
C15	Lack of periodical increment	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
C16	Lack of professional training and advanced learning opportunities	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐

Code	Constraint	Severity level					Probability of occurrence				
		No severity	Moderate severity	Strong severity	Very strong severity	Extreme severity	Unlikely to happen	May happen	Likely to happen	Very likely to happen	Certain to happen
C17	Lack of recognition of efforts	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
C18	Material unavailability	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
C19	Not enough challenging task	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
C20	Not enough responsibility	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
C21	Overcrowded work areas	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
C22	Overloads and working long hours	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
C23	Personal life interference	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
C24	Poor communication	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
C25	Poor inspection and supervision	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
C26	Poor relationship	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
C27	Poor work conditions	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
C28	Quarrels and hassles	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
C29	Rework	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
C30	Strict company policy	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
C31	Tool unavailability	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
C32	Underpayment for the work done	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
C33	Unrealistic contract duration	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
C34	Unskilled labor force	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
C35	Work dissatisfaction	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐

Sincerely thank you for your help!

QUESTIONNAIRE SURVEY
For construction masonry workers

Dear Sir/Madam,

I am Nguyen Van Tam, a Ph.D. student at Kochi University of Technology, Japan.

This questionnaire aims to identify and examine engaging leadership, psychological and motivational factors regarding improving the labor productivity of construction workers on sites. I hope from you is a frank and impartial opinion based on your viewpoint and practical experience. Your personal information and all the answers will remain confidential; all the information will be analyzed for research purposes only.

Please choose the most recently completed (or implementing) construction project on which you were personally involved and provide appropriate answers to the questions/or descriptions below:

A- Demographic information

1. Name:……Phone:……..……
2. Gender: ☐Male ☐ Female
3. Age (years): ……
4. Education level:
    1. ☐ No education ☐ Primary school
    2. ☐ Secondary school ☐ High school and above
5. Your training experience in the construction industry is (years): ……
6. Your experience in the construction industry is (years): …….
7. Marital status
    1. ☐ Single ☐ Married
8. Weight:…….kg Height:…….cm
9. Your income average per month from construction works is: ……(VND mil.)

B- Survey on engaging leadership, psychological and motivational factors affecting construction workers' productivity on sites

Please answer the following statements based on your viewpoint and practical experience

(2- Strongly Disagree; 2- Disagree; 3 – Neutral; 4 – Agree; 5 - Strongly Agree)

Code	Construct items	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
	Engaging Leadership					
	Strengthening					
EL1	My supervisors encouraged me to develop knowledge and skills as much as possible on my tasks	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
EL2	My supervisors encouraged me to develop my talents as much as possible on my tasks	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
EL3	My supervisors delegate specific tasks and responsibilities to each member of my team	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
EL4	My supervisors encouraged me to use my own strengths on tasks	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
EL5	My supervisors encouraged me to overcome the challenging tasks	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
	Connecting					
EL6	My supervisors encouraged collaboration among team members on sites	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
EL7	My supervisors encourage support among team members on our tasks	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
EL8	My supervisors promote team connection by creating a comfortable working atmosphere on our tasks	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
	Empowering					
EL9	My supervisors give me enough freedom and responsibility to complete my tasks	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
EL10	My supervisors listen to how I would like to do things in improving my work efficiency	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
EL11	My supervisors appreciated my contribution to my team on tasks	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
EL12	My supervisors encouraged me to ask questions and give my own opinions	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
	Autonomy Satisfaction					
AS1	I feel that my decisions reflect what I really want	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
AS2	I feel my choices express who I really am	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
AS3	I feel I have been doing what really interests	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
AS4	I feel a sense of choice in the tasks I undertake	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
AS5	I feel freedom in the tasks I undertake	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
	Competence Satisfaction					
CS1	I feel competent to achieve my goals and company goals	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
CS2	I feel I can successfully complete difficult or challenging tasks	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
CS3	I feel capable of what I do on site	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
CS4	I feel confident that I can do things well	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐

Code	Construct items	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
CS5	I feel effective in what I do on site	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
CS6	I feel a have sufficient work-related skills or knowledge on site	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
	Relatedness Satisfaction					
RS1	I feel close and connected with other people on site (e.g., supervisor, teammates)	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
RS2	I feel connected with people who care for me, and for whom I care (e.g., family, supervisor, teammates)	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
RS3	I experience a happy feeling with the people I spend time with	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
RS4	I feel that the people I care about also care about me	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
RS5	I experience a comfortable feeling with the people I spend time with	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
RS6	My supervisors and teammates help me when I need help.	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
Why do you or would you put effort into your current job?						
	Amotivation					
Amot1	I don't know why I am doing this job; it's pointless work	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
Amot2	I do little because I don't think this work is worth putting try into	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
Amot3	I don't because I really feel that I'm wasting my time at work	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
Amot4	But I do not have a good reason for work	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
	Intrinsic motivation *(Autonomous motivation)*					
Intri1	Because it is really important for me	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
Intri2	Because what I do in my job is exciting	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
Intri3	Because I have fun doing my job	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
Intri4	Because I have a chance to learn new things/new skills	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
Intri5	Because I would feel there are many benefits to do it	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
Intri6	Because I enjoy finding valuable solutions from various teammates	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
Intri7	Because I interested in challenging tasks	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
Intri8	Because I will be delegated more authority	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
	Integrated regulation *(Autonomous motivation)*					
Inte1	Because it is really a part of who I am	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
Inte2	Because it is very meaningful for me	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
Inte3	Because it is something, I value deeply	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
Inte4	Because it is in line with my personal goals	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
Inte5	Because putting try into this job aligns with my personal values	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
	Identified regulation *(Autonomous motivation)*					

Code	Construct items	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
Iden1	Because I personally consider it important to put try into this job	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
Iden2	Because I try to improve my skills in my works	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
Iden3	Because putting try into this job holds personal significance for me	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
Iden4	Because I will be delegated authority or will be participated in decision-making	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
Iden5	Because I receive appropriate feedback from others (e.g., supervisor, teammates)	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
	Introjected regulation *(Controlled motivation)*					
Intro1	Because I have to prove to myself that I can	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
Intro2	Because I would feel bad about myself if I did not	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
Intro3	Because it makes me feel proud of myself	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
Intro4	Because otherwise, I would feel ashamed of myself	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
Intro5	Because it bothers me when I do not	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
Intro6	Because otherwise, I would feel bad about myself	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
	External regulation *(Controlled motivation)*					
Exter1	Because I work to get others' approval (e.g., supervisor, teammates)	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
Exter2	Because others will respect me more (e.g., supervisor, teammates, family)	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
Exter3	Because I try to avoid being criticized by others (e.g., supervisor, teammates)	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
Exter4	Because that is what I am supposed to do	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
Exter5	Because others would not be disappointed in me (e.g., supervisor, teammates, family)	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
Exter6	Because I could lose my job if I don't put enough try into it	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
Exter7	Because I will be rewarded financially only if I put enough try into my job	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
Exter8	Because I work at safety and health conditions	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
Exter9	Because I received good support from others in my work (e.g., supervisor, teammates)	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
	Work Engagement					
	Physical engagement					
WE1	I do my best because I consider the interests of the company to be my interest	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
WE2	I always try improving my labor productivity by fully exercise my strengths in my tasks	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
WE3	I work extra hours to make work procedures smooth and complete my work before the deadline	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
WE4	I agree with most of the company's policies toward employees	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐

Code	Construct items	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
WE5	I always make an extra try for the company by increasing the work efficiency of my team	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
WE6	I engage in extra activities to build good relationships with others (e.g., supervisor, teammates)					
WE7	I participate in training courses in order to improve my knowledge and skills	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
WE8	I always follow the work process in order to ensure my work efficiency	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
WE9	I always follow the rules/regulations in workplace in order to ensure my work efficiency	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
WE10	I try to learn new things in order to accumulate my knowledge and skills	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
	Cognitive engagement					
WE11	I feel my work is everything to me; hence, I always try improving my labor productivity	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
WE12	I am willing to work extra hours to make work procedures smooth and complete my work before the deadline	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
WE13	I am willing to make an extra try for the company by increasing the work efficiency of my group	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
WE14	I am willing to engage in extra activities to build good relationships with others (e.g., supervisor, teammates)	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
WE15	I am willing to participate in training courses in order to improve my knowledge and skills	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
WE16	I am willing to follow the work process in order to ensure my work efficiency	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
WE17	I am willing to follow the rules/regulations in workplace in order to ensure my work efficiency	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
WE18	I am willing to learn new things in order to accumulate my knowledge and skills	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
	Emotional engagement					
WE19	I am enthusiastic about my tasks on site	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
WE20	I feel energetic at my tasks on site	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
WE21	I am interested in my tasks on site	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
WE22	I am happy to accept any tasks assigned by the management team, as long as they fall within a reasonable scope	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
WE23	I feel positive about my tasks on site	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
WE24	I am excited about my tasks on site	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐

B- Measurement of workers' productivity in several main masonry works on sites (for civil buildings)

Based on your practical experience construction in civil buildings, please estimate your productivity in the following construction tasks
These figures are estimated for labor productivity of per worker working per shift (8 hours) on-site.

Constructing wall and finishing works (only for masonry worker)

LP1. Constructing straight walls of baked clay brick

[1]☐ < 0.6 m3 [2]☐ 0.6 – 0.7 m3 [3]☐ 0.71 – 0.8 m3

[4]☐ 0.81 – 0.9 m3 [5]☐ > 0.9 m3

LP2. Constructing straight walls of concreting brick

[1]☐ < 0.7 m3 [2]☐ 0.7 – 0.8 m3 [3]☐ 0.81 – 0.9 m3

[4]☐ 0.9 – 1.0 m3 [5]☐ > 1.0 m3

LP3. Constructing exterior wall plaster

[1]☐ < 4.0 m2 [2]☐ 4.0 – 4.5 m2 [3]☐ 4.6 – 5.0 m2

[4]☐ 5.1 – 6.0 m2 [5]☐ > 6.0 m2

LP4. Constructing interior wall plaster

[1]☐ < 4.5 m2 [2]☐ 4.5 – 5.0 m2 [3]☐ 5.5 – 6.0 m2

[4]☐ 6.0 – 6.5 m2 [5]☐ > 6.5 m2

LP5. Constructing floor tiling work

[1]☐ < 5.5 m2 [2]☐ 5.5 – 6.5 m2 [3]☐ 6.6 – 7.5 m2

[4]☐ 7.6 – 8.5 m2 [5]☐ > 8.5 m2

C- Survey on factors constraining work motivation cause of decreasing workers' productivity on sites

Please assess the level of each factor constraining work motivation cause of decreasing workers' productivity on sites in the following questions:

3. How much its severity level decrease workers' productivity?

(No severity; 2- Moderate severity; 3 – Strong severity; 4 – Very strong severity; 5 – Extreme severity)

4. How often it is considered on sites? (probability of occurrence)

(1-Unlikely to happen, 2-May happen, 3-Likely to happen, 4-Very likely to happen, 5-Certain to happen)

Code	Constraint	Severity level					Probability of occurrence				
		No severity	Moderate severity	Strong severity	Very strong severity	Extreme severity	Unlikely to happen	May happen	Likely to happen	Very likely to happen	Certain to happen
C1	Bad treatment by the supervisors	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
C2	Changing on workmates	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
C3	Delay in responding to Requests for Information	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
C4	Delay payment	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
C5	Health personal problems	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
C6	Inadequate managerial competence	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
C7	Inappropriate evaluation and feedback	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
C8	Inclement weather	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
C9	Incompetent teammates	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
C10	Laborers' disloyalty	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐

Code	Constraint	Severity level					Probability of occurrence				
		No severity	Moderate severity	Strong severity	Very strong severity	Extreme severity	Unlikely to happen	May happen	Likely to happen	Very likely to happen	Certain to happen
C11	Lack of cooperation	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
C12	Lack of discipline on site	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
C13	Lack of financial incentive schemes	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
C14	Lack of participation in decision making	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
C15	Lack of periodical increment	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
C16	Lack of professional training and advanced learning opportunities	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
C17	Lack of recognition of efforts	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
C18	Material unavailability	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
C19	Not enough challenging task	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
C20	Not enough responsibility	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
C21	Overcrowded work areas	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
C22	Overloads and working long hours	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
C23	Personal life interference	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
C24	Poor communication	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
C25	Poor inspection and supervision	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
C26	Poor relationship	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
C27	Poor work conditions	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐

Code	Constraint	Severity level					Probability of occurrence				
		No severity	Moderate severity	Strong severity	Very strong severity	Extreme severity	Unlikely to happen	May happen	Likely to happen	Very likely to happen	Certain to happen
C28	Quarrels and hassles	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
C29	Rework	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
C30	Strict company policy	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
C31	Tool unavailability	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
C32	Underpayment for the work done	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
C33	Unrealistic contract duration	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
C34	Unskilled labor force	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
C35	Work dissatisfaction	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐

Sincerely thank you for your help!