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INFLUENCE OF WORKFORCE ON PRODUCTIVITY OF LABOUR INTENSIVE WORKS ON FEEDER ROAD CONSTRUCTION IN GHANA

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ABSTRACT

Construction labour productivity is regarded as an effective indicator of the efficiency of industry activities. This research aims to develop a labour productivity framework based on worker component in achieving construction labour productivity in labour-intensive public works in Ghana. The objectives are to identify the factors that affect labour productivity on the sites and evaluate the effect of the identified factors that affect labour productivity in Ghana and develop a worker framework for labour-intensive works. Purposive sampling technique was used to select 40 districts as they were into road construction projects. Out of 120 sites, one facilitator, one-time keeper, one site engineer and one contractor from each site were selected making a total of 480 respondents and 80 comprised district engineers and GSOP desk officers. Out of 560 respondents, 543 gave a complete response to the questionnaire which gave a response rate of 97%. Exploratory factor analysis was used to classify the factors into components and structural equation modelling was used to develop the worker component labour productivity framework in which the importance of the factors in the component was evaluated based on the strength of their impact. Principal axis factoring revealed the presence of four (4) components with eigenvalues above 1 and these are Component Age of worker; Workers' knowledge; Safety Compliance and Motivation of worker. However, the structural equation modelling indicated the motivation of workers and the age of workers influenced the worker component with 0.662 and 0.614 as correlation figures respectively. The novelty of this study also lies in the labour productivity framework for labour-intensive works on road construction, it informs as to the variables that affect the worker component that determines labour productivity of labour-intensive works on road construction in the Ghanaian construction industry.

Keywords: *Ghana; Intensive; Labour; Productivity; Road; Workforce*

INTRODUCTION

The labour-intensive Public Works pilot under the Ghana Social Opportunities Project (GSOP) has yielded impressive results. After 10 years of implementation, six hundred thirty-four

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communities in sixty district assemblies have benefitted from the labour-intensive works in road construction. 7,879,360 man-hours of employment were created for 167,245 persons, 61% of whom were females. The areas of the intervention included climate change mitigation activities, small earth dams and feeder roads (World Bank, 2017).

According to the Ghana, Living standards survey seven (GLSS 7:2017/2018), the majority of economically active poor are either semi-skilled or lack the requisite skills to enable them to compete on the formal labour market. Over the years, labour-intensive techniques are effective means of providing the income-earning opportunity for the economically active poor and ensuring the transfer of vocational and technical skills through "learning by doing" and formal training opportunities.

In Ghana, many construction projects end in dispute because contractors are unable to meet the completion time (Fugar, and Agyakwah-Baah, 2010). As many construction operations are labour intensive, the question of labour productivity becomes paramount especially as higher productivity levels typically translate into superior profitability, competitiveness, and income (Rojas and Aramvareekul, 2003).

Unfortunately, the lack of reliable means for evaluating the efficiency of labour-intensive construction operations seems to make it more difficult for the construction industry to improve productivity and ensure the more effective development of the vital infrastructure that society demands. Construction projects are generally unique and are built on sites with different work crews associated with different trades, levels of education.

Frimpong, Oluwoye, and Crawford (2003) claimed that a successful construction project is one that is completed on time, within budget, meeting specified standards of quality, and strictly conforming to safety policies and precautions. All of these are feasible only if the predetermined levels of productivity can be achieved. Nevertheless, productivity or lack thereof is one of the construction industry's most prevalent problems. Owing to the nature of construction projects, its importance to society and the existing economic resources, more emphasis should be given to improving productivity.

El-Gohary and Aziz (2014) revealed that contractors' construction time and cost depend on the output of the labour. However, delays in the construction industry have raised a general concern by the public to determine what is happening. Considering the basic resources that were/ are available to the construction industry, productivity remains a dominant issue in the construction sector (El-Gohary and Aziz, 2014).

This research aims to develop a productivity framework based on worker component that influences productivity in labour-intensive works in Ghana. The objectives are to identify the factors that affect labour on the site and evaluate the effect of the identified factors that affect labour productivity in Ghana and develop a worker framework for labour-intensive works.

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THEORETICAL FRAMEWORK LABOUR PRODUCTIVITY INVOLVING WORKER COMPONENT

Improving productivity is a major concern of any profit-orientated organization as representing the effective and efficient conversion of resources into marketable products and determining business profitability.

According to Lindsay (2004), productivity is defined as a measure of the ability to create goods and services from a given amount of labour, capital, materials, land, knowledge, time, or any combination of these. On the other hand, Jarkas and Bitar (2012) defined productivity as the relationship between output and the means employed to produce that output. A more industry-relevant definition that is widely accepted among construction industry stakeholders expresses productivity in the context of performance measurement–i.e. as a measure of how well resources are leveraged to achieve set targets or desired outputs (Durdyev and Mbachu 2018). In this way, it is possible to speak of the productivity of production factors such as capital, investment, or raw materials according to whether the output is being considered concerning capital, investment or raw materials. This means that productivity depicts the degree of quality of characteristics of production factors. Output in this context can be seen as an outcome of the process, whether a product or service, while input factors consist of any human and physical resources used in a process.

Zayed and Halpin (2005) studied labour productivity and concluded that personnel for pile construction is also a contributing component in ensuring productivity in the construction sites. The skill of the labourers was considered as paramount when it comes to this specialized form of construction. The latter has been verified by Dai, Goodrum, and Maloney (2009), who took a "bottom-up" approach by examining the craft workers' perceptions in the US regarding the relative impact of 83 productivity factors (e.g. behavioural issues, safety, project management, communication skills) through a series of focus groups sessions.

Hence, productivity itself represents the ability of workers to produce output. The higher the output produced by a worker, the higher the productivity level of the worker. Although there are endless definitions for productivity, they all refer to productivity as a comparison of input versus output. Indeed, the managerial input into the production process, while often invisible, has a great influence on productivity levels. The main characteristics of the productivity concept that stood out from all these various definitions of productivity included the capacity to produce that is the force behind production itself; effectiveness of productive efforts as a measure of how well the resources are utilized and the final point is the production per unit of effort (or rate) to measure the output of the factors of production over a defined period.

The operational definition of labour productivity appropriate to this research study is the volume to work-hours utilise and production. It is also, the correlation relating to quantities of input factors utilised by a system to produce output and the output produced by a system.

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Jarkas and Bitar (2012) noted that workforce or labour cost accounts for 30–50% of the total project. Thus, considering the workforce plays a key role in achieving a higher level of productivity performance, construction professionals should pay more attention to the workforce dimension (Durdyev, Ismail, and Kandymov, 2018). According to Abdel-Wahab (2008), the effective utilization of skills rather than a mere increase in the supply of skills is key to bringing about productivity improvements.

Hence, based on the labour productivity theories, management, work-based conditions, worker, equipment and material components were all identified as factors that affect labour productivity. Also, it was foreseen that temperature component (Thermal Environmental Consideration) also affect labour productivity through the theories did not address it.

There has been limited research on models reflecting the relationship between thermal environment and Construction labour productivity (CLP) in Ghana. However, these limited models even failed to accurately demonstrate the productivity performance in hot and humid environment considering human body heat tolerance limit.

Zayed and Halpin (2005) theory on labour productivity was adopted due to the influence of worker component that was identified by Tylor's theory as affecting productivity. Khosrowpour, Niebles, and Golparvar-Fard (2014) noted one efficient way to manage workers' performance is to monitor their activity on site, analyze the operation in real-time, and optimize the workflow dynamically. Recognition of worker behaviour can be performed at various levels of abstraction.

Dixit, Pandey, Mandal, and Bansal (2017), argued work overload and rework has a strong and significant impact on the productivity of construction because every time there is a rework it has loss of manpower, material, money and other resources and there will be more waste to deal with. To avoid productivity losses due to work overload and rework is to have good coordination among the engineers and supervisor and the quality of work should be maintained and the approach of first time right shall be developed by all stakeholders of the project.

Horner, Talhouni, and Thomas (1989) identified the factors influencing worker component as the skill of labour; crew size and composition; the total number of operations on-site; absenteeism and incentive scheme. Soekiman, Pribadi, Soemardi, and Wirahadikusumah (2011), explored various factors affecting labour productivity in and shortlisted the following as most significant which included labour strikes and higher absenteeism of labour.

RESEARCH METHODOLOGY

Stratified sampling technique was used, based on the diverse nature of the population hence was adopted to select 40 out of the 60 districts where the labour intensive projects on road construction were carried out. Since not all the district offices were handling road construction projects, purposive sampling technique was used to select 40 districts as they were into road construction

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projects. One district engineer and one GSOP desk officer were selected from each district making 80 respondents. Again, 3 sites from each district were selected making a total of 120 districts. Of the 120 sites, one facilitator, one timekeeper, one site engineer and one contractor from each site were selected making a total of 480 respondents. Out of 560 respondents, 543 gave a complete response to the questionnaire which gave a response rate of 97%. Exploratory factor analysis was used to classify the factors into components. The labour productivity framework was developed by regressing the factor scores for labour productivity against the latent components. The idea of using this approach is similar to that of the structural equation model but allows more flexibility in the development of the framework.

FINDINGS AND DISCUSSION

The results of the Mean, Standard Deviation and rank of Item Score of the data are presented and discussed in the following session.

Table 1. Descriptive Statistics for Worker component (WC)

Factors	**Mean**	**SD**	**Rank**
The company's incentive scheme for good performance	4.12	0.976	1
Opportunities for employees to exercise their skills	4.11	0.697	2
Likelihood workers are paid on time	4.10	0.986	3
Management response to settle employee's grievances	4.03	1.018	4
Employees' knowledge of scientific techniques	3.95	0.839	5
Workers' attitude towards the job they have to execute	3.91	0.852	6
Workers' knowledge of career prospects	3.88	0.921	7
Promotion opportunities for employees	3.86	1.160	8
Employment of young workers on projects	3.83	1.464	9
Employees' level of experience to do their work	3.77	0.496	10
Likelihood older workers will be replaced by younger workers	3.69	1.173	11

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Level of safety achieved on projects	3.67	0.963	12
Employment of older workers from villages	3.60	1.234	13
Employees level of awareness of company policy	3.59	0.964	14
Incentives used to attract young people into the sector	3.59	1.727	15
The number of multi-skilled project personnel in the company	3.57	0.591	16
Quality of transportation facilities for workers	3.53	1.057	17
The usage of safety wear on site	3.21	0.961	18
The degree to which safety standards on a project comply with legislated criteria	3.08	1.098	19

The results from the descriptive analysis indicated that nineteen (19) variables of the listed worker component were identified. The findings indicated that rankings of the worker component (WC) that can promote the labour productivity of labour-intensive works on road construction. It was observed that 'The company's incentive scheme for good performance' was ranked first with a mean score of 4.12, 'Opportunities for employees to exercise their skills' was ranked second with a mean score of 4.11, 'Likelihood workers are paid on time' was ranked third with a mean score of 4.10, 'Management response to settle employee's grievances' was ranked fourth with a mean score of 4.03, and 'Employees' knowledge of scientific techniques' was ranked fifth with a mean score of 3.95.

'Workers' attitude towards the job they have to execute' was ranked sixth with a mean score of 3.91, 'Workers' knowledge of career prospects' was ranked seventh with a mean score of 3.88, 'Promotion opportunities for employees' was ranked eighth with a mean score of 3.86, 'Employment of young workers on projects' was ranked ninth with a mean score of 3.83, and 'Employees' level of experience to do their work' was ranked tenth with a mean score of 3.77.

Moreover, 'Likelihood older workers will be replaced by younger workers' was ranked eleventh with a mean score of 3.69, 'Level of safety achieved on projects' was ranked twelfth with a mean score of 3.67, 'Employment of older workers from villages' was ranked thirteenth with a mean score of 3.60, 'Employees level of awareness of company policy' was ranked fourteenth with a mean score of 3.59, and 'Incentives used to attract young people into sector' was ranked fifteenth with a mean score of 3.59.

Besides 'The number of multi-skilled project personnel in the company' was ranked sixteenth with a mean score of 3.57, 'Workers' having formal training in labour-intensive works' was ranked seventeenth with a mean score of 3.54, 'Quality of transportation facilities for workers' was ranked eighteenth with a mean score of 3.53, 'The usage of safety wear on-site' was ranked nineteenth

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with a mean score of 3.21, and 'Degree to which safety standards on a project comply with legislated criteria' was ranked twentieth with a mean score of 3.08.

Results from Exploratory Factor Analysis

The results from the EFA on the worker component that can promote labour productivity of labour-intensive works on road construction are presented in Tables 2 to 3 and Figure1 Out of the twenty (20) variables listed, the following four (4) were omitted: 'Workers' having formal training in labour-intensive works' (WC 1) and 'Employees level of awareness of company policy' (WC6), 'Workers' knowledge of career prospects' (WC 10) "Likelihood workers are paid on time' (WC12) and 'Degree to which safety standards on a project comply with legislated criteria'.

Owing to the industry's labour-intensive nature, the workforce factor plays a significant role in the construction project implementation process (Bernold and AbouRizk, 2010). Jarkas and Bitar (2012) confirmed that workforce accounts for 30–50% of the total project cost. Consequently, considering the worker component's key role in achieving a higher level of productivity performance, construction professionals should pay more attention to the workforce dimension, which has four observable variables in line with the relevant findings: (i) Age of the worker (Zeiss, 2007) (ii) workers knowledge (Mojahed and Aghazadeh, 2008; Alinaitwe et al., 2007); (iii) safety compliance (Abrey and Smallwood, 2014) and (iv) level of motivation (Kazaz, Manisali, and Ulubeyli, 2008; Bernold and AbouRizk, 2010)

Table 2. Pattern factor loading for Worker Component

	Component			
	1	2	3	4
WC19 Employment of older workers from villages	0.954	0.22	0.065	0.041
WC18 Employment of young workers on projects	0.914	-0.279	0.001	0.126
WC20 Incentives used to attract young people into sector	0.776	-0.406	-0.068	-0.227
WC17 Likelihood older workers will be replaced by younger workers	0.774	-0.134	0.3	0.26
WC2 Employees' level of experience to do their work	0.073	-0.172	0.24	-0.817

WC3 The number of multi-skilled project personnel in the company	0.119	0.789	-0.06	-0.188
WC4 Employees' knowledge of scientific techniques	-0.081	0.717	0.307	-0.33
WC1 Workers' having formal training in labour-intensive works	-0.473	0.565	0.302	-0.337
WC6 Employees level of awareness of company policy	0.701	0.548	-0.212	-0.104
WC8 Opportunities for employees to exercise their skills	0.343	0.82	0.027	-0.106
WC11 Workers' attitude towards the job they have to execute	0.034	0.927	0.055	0.142
WC16 The usage of safety wear on site	-0.065	0.031	0.952	0.23
WC15 Degree to which safety standards on a project comply with legislated criteria	0.528	0.291	0.636	-0.276
WC14 Level of safety achieved on projects	-0.253	0.198	0.798	-0.165
WC13 Quality of transportation facilities for workers	-0.246	-0.135	-0.127	0.858
WC7 The company's incentive scheme for good performance	-0.195	0.221	0.191	0.787
WC10 Workers' knowledge of career prospects	0.015	-0.004	0.628	0.645
WC12 Likelihood workers are paid on time	0.422	-0.031	0.419	-0.577
WC9 Management response to settle employee's grievances	-0.115	0.091	-0.31	0.854
WC5 Promotion opportunities for employees	0.28	0.121	-0.09	0.711

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The Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy achieved a value of 0.892, exceeding the recommended minimum value of 0.7 and Bartlett's test of sphericity was also statistically significant (less than 0.05), thus supporting the factorability of the correlation matrix.

Principal axis factoring revealed the presence of four (4) components with eigenvalues above 1 as shown in Table 2. Based on the examination of the inherent relationships among the variables under each factor, the following interpretations were made. Component 1 was termed Age of worker Component 2 Workers' knowledge; Component 3 Safety Compliance and Component 4 Motivation of worker. The names given to these components were derived from a close examination of the variables within each of the factors. The constituent indicators of each of the three components extracted are explained below, together with a detailed description of the nature of how each was described within the focus group sessions.

Component 1: Age of worker
The four (4) extracted Worker component (WC)**,** variables on component 1 were Employment of older workers from villages (95.4%), Employment of young workers on projects (91.4%), Incentives used to attract young people into the sector (77.6%) and Likelihood older workers will be replaced by younger workers (77.4%). The number in parenthesis indicates the respective factor loadings. This cluster accounted for 36.4 percent of the variance.

Component 2: Workers' Knowledge
The seven (7) extracted worker component (WC)**,** variables for Component 2 were Workers' attitude towards the job they have to execute (92.7%), Opportunities for employees to exercise their skills (82%), Employees' level of experience to do their work (81.7%), The number of multi-skilled project personnel in the company (78.9%), Employees' knowledge of scientific techniques (71.7%), Employees level of awareness of company policy (70.1%) and Workers' having formal training in labour-intensive works (56.5%). The number in parenthesis indicates the respective factor loadings. This cluster accounted for 23.3 percent of the variance.

Component 3: Safety Compliance
This cluster accounted for 16.8 percent of the variance. The three (3) extracted worker component variables for component 3 were the usage of safety wear on site (95.2%), and Level of safety achieved on projects (79.8%) Degree to which safety standards on a project comply with legislated criteria (63.6%). The number in parenthesis indicates the respective factor loadings.

Component 4: Motivation of worker
The six (6) extracted worker component (WC)**,** variables for Component 4 were Quality of transportation facilities for workers (85.8%), Management response to settle employee's grievances (85.4%), The company's incentive scheme for good performance (78.7%), Promotion opportunities for employees (71.71), Workers' knowledge of career prospects (64,5%) and Likelihood workers are paid on time (57.7%). The number in parenthesis indicates the respective factor loadings. This cluster accounted for 6.8 percent of the variance.

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The Measurement Framework of Worker Component Construct

Then the worker component was identified as contributing to labour productivity on sites of labour-intensive works. It had regression correlations of 0.662 and 0.614 which involved the motivation of workers and the age of workers as illustrated in figure 1. Worker component factors 1 represented age of worker and factor 2 included motivation of workers component, was significant. Since labour intensive project as part of social intervention programmes to support the poor in society government through the local authority or district assemblies recruit the beneficiaries or labourers to carry the task many at times employ many individuals from the community where the project is carried out without conforming with the method statement hence crowded crew size are used on a particular project hence affecting the productivity.

Since the remuneration is not attractive enough many younger ones do not come forward to be employed as a result greater percentage of the aged individual from the ages of 55 years to 68 years were recruited to engage in the labour-intensive works which go a long way to affect productivity negatively. In most of the sites visited it was observed that most aged were used to carry out the tasks hence resulting in low productivity due to their failing strength. Incentives used to attract young participants must be encouraged to engage in the labour-intensive works. Also, there is a need to motivate the workers to give up their best this include prompt payment of the wages on time. If the beneficiaries or labourers are over-burdened, their capacity to undertake other income-earning activities will be affected, and ultimately they may be disempowered resulting in low productivity. Wages need to be paid in full and on time to meet the minimum wage. When the participants are motivated including likelihood participants are paid on time and management response to settle employee’s grievances it will go a long way to improve the productivity on sites.

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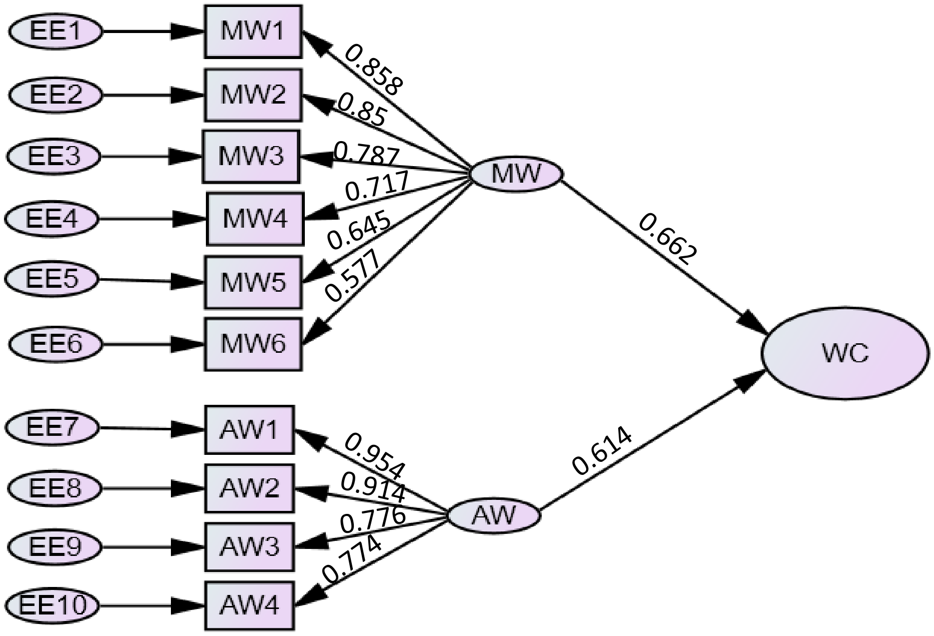

Figure 1. Worker component labour productivity framework construct based on regression analysis

Table 3: Guidelines for using the Worker Component labour productivity framework for labour-intensive works on road construction

NO	Component	Activity
1	Worker Component	**Motivation of worker (MW)** i. Bonus systems for good attendance can be considered ii. Emphasis should be placed on the operation of the remuneration system. iii. Where productivity-based payment is used, steps should be taken to protect against abuse under different implementation strategies. iv. Limit competitive pressure among workers from different construction firms by ensuring collective bargaining over wage and task rate.
		Age of Worker (AW) Energetic youths from the age of 18 years and 40 years should be encouraged to take part in the project.

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CONCLUSION

The postulation for the overall framework was that the overall labour productivity for labour-intensive public works on road construction is directly related to the influence of the exogenous (latent) variables in predicting or determining successful outcomes.

The results from the exploratory factor analysis on the worker component that can promote labour productivity of labour-intensive works on road construction included four main factors which are Age of worker, Workers' Knowledge, safety compliance and motivation of workers.

Since the industry's labour-intensive nature, the workforce factor plays a significant role in the construction project implementation process. Jarkas and Bitar (2012) confirmed that workforce accounts for 30–50% of the total project cost. Consequently, considering worker component's key role in achieving a higher level of productivity performance, construction professionals should pay more attention to the workforce dimension, which has four observable variables in line with the relevant findings: (1) Age of the worker (Zeiss 2007) (2) workers knowledge (Alinaitwe, Mwakali, and Hansson, 2007); (3) safety compliance (Abrey, and Smallwood, 2014) and (4) level of motivation (Kazaz, Manisali, and Ulubeyli, 2008)

Moreover, it was found that the variables have a significant direct influence on the endogenous variables in determining the outcomes of labour productivity for labour-intensive public works on road construction.

Moreover, construction professionals could use this knowledge to help with decision making in the firm. This research study can also be introduced as an important tool in planning to fast-track the effective utilisation of road construction work using the labour-intensive approach to improve on productivity by completing the work as scheduled in the contract.

Having the right curriculum that addresses current trends and needs in the industry will enable built environment teachers to teach subjects that are relevant to the industry for which they are producing graduates. Thus, they will be preparing graduates who are equipped with the requisite competencies for labour-intensive works projects since most of them end up as supervisors, site engineers, and quantity surveyors. Hence, the current findings of this study could help in the design of curriculum for teaching and learning in higher learning especially concerning labour productivity in the construction industry. Furthermore, it will provide the basis for curriculum review.

The novelty of this study also lies in the labour productivity framework for labour-intensive works on road construction, it informs as to the variables that affect the worker component that determines labour productivity of labour-intensive works on road construction in the Ghanaian construction industry. Similarly, the latent variables which led to the labour productivity outcome variables could be used for firms' labour productivity measurement in the Ghanaian construction industry.

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