EFFECT OF SOCIOEMOTIONAL, COGNITIVE, AND TECHNICAL COMPETENCIES OF WORKERS ON CONSTRUCTION LABOR PRODUCTIVITY

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by

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Dedicated to

Late. Dr. Manoj Kulshrestha

and

Dr. (Col.) Nishith Bihari Saxena

CERTIFICATE

This is to certify that the thesis entitled "**Effect of socioemotional, cognitive, and technical competencies of workers on construction labor productivity"**, being submitted by **Mr. Sparsh Johari** to the Indian Institute of Technology Delhi for the award of the degree of **Doctor of Philosophy** is a bonafide record of the research work carried out by him under my supervision and guidance. The thesis work, in my opinion, has reached the requisite standard, fulfilling the requirements for the degree of Doctor of Philosophy.

The contents of this thesis, in full or in parts, have not been submitted to any other University or Institute for the award of any degree or diploma.

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ABSTRACT

A construction worker is a worker employed in manual labor of the physical construction of the built environment and its infrastructure. In terms of working hierarchy, construction workers belong to the lowest most strata of the construction industry. They directly involved in performing the tasks at site, and thus their level of competency plays an important role in defining construction labor productivity. The construction labor productivity (CLP) is a single-factor productivity, where labor hours are used as the input unit and the quantity of finished work as output. Therefore, to enhance the performance of the workers by improving their specific competencies, workplace training systems have been developed. In such training system, workers learn working methodologies, new technologies, and the way to work at site. These training systems have fixed training curriculum and training time. However, these training systems have one major constraint, that is, the outcome of such trainings in terms of the percentage of increase in workers' performance is not generally measured. This lack of measurement causes two issues. First, the contractors do not able to recognize the importance of training in enhancing workers' performance. Second, the training providers do not receive constructive feedback on the efficacy of their training sessions.

This study therefore attempts to bridge this gap by conducting a nationwide survey of 598 industrial professionals in India, to identify six, nine, and thirteen competencies for unskilled, semi-skilled, and skilled categories of workers, respectively, which affect their performance at site. These competencies included behavioral attributes, motivation, and physical strength for unskilled workers; self-confidence, and technical knowledge for semi-skilled workers; and writing, reading, mathematical, and problem-solving competencies for skilled workers. Further, the author quantified each of these

competencies of the workers at construction site using survey instruments, which were identified through literature. Along with the measurement of the competencies, the productivity of the same workers was also measured via direct observation at sites. By applying various best-fit curve models to the collected data (measured competencies and productivity), best-fit curves were developed between each of the competencies and observed productivity. Subsequently, a regression model was developed by considering all the measured competencies as explanatory variables and productivity as dependent variable. Thereafter, the author visited four training centers in India and measured all the identified competencies of 137 trainee workers periodically (every 2 days of a 90-day training). This periodical data on competencies of the workers was fed into the developed regression model to compute their performance increment during their training. Subsequently, a learning curve was drawn between the performance increment of the workers and their training time. In addition, the competencies versus training time curves were also plotted to understand how competencies of the workers were enhancing during their training.

The results indicate that workers' performance after training was far below the desired level of employers; the reason for this emerges from competencies versus training time curves, where it was found that training does not focus on enhancing socioemotional and cognitive competencies. Therefore, the study recommends that training providers incorporate these competencies in training curriculum to achieve more desirable outputs from the training. This will help in designing and implementing an effective workers' training program.

Keywords: Construction labor productivity, correlation analysis, path analysis, regression analysis, skill development training, worker skills

कार्यस्थल प्रशिक्षण का उद्देश्य अपनी विशिष्ट दक्षताओं में सुधार करके प्रशिक्षुओं के प्रदर्शन को बढाने का होता है। दुर्भाग्य से, प्रशिक्षुओं के प्रदर्शन में वृद्धि के प्रतिशत के संदर्भ में इस तरह के प्रशिक्षणों के परिणाम को आमतौर पर मापा नहीं जाता है। एक ओर, प्रशिक्षणों के परिणाम को न मापने के कारण कांट्रैक्टर प्रशिक्षण के महत्व को नहीं पहचान पाते है, और दूसरी ओर, प्रशिक्षण प्रदाताओं को अपने प्रशिक्षण सत्रों की प्रभावकारिता पर रचनात्मक प्रतिक्रिया भी नहीं मिलती है।

इसलिए यह अध्ययन क्रमशः भारत में 598 औद्योगिक पेशेवरों की मदद से अकुशल, अर्ध-कुशल और श्रमिकों के छह, नौ और तेरह दक्षताओं की पहचान करता है, जो साइट पर उनके प्रदर्शन को प्रभावित करता है। इन दक्षताओं में अकुशल श्रमिकों के लिए व्यवहारिक विशेषताएँ, प्रेरणा और शारीरिक शक्ति शामिल है; अर्ध-कुशल श्रमिकों के लिए आत्मविश्वास और तकनीकी ज्ञान शामिल है; और कुशल श्रमिकों के लिए लेखन, पठन, गणितीय, और समस्या को सुलझाने की क्षमता शामिल है । इसके अलावा, लेखक ने सर्वेक्षण उपकरणों का उपयोग करके निर्माण स्थल पर श्रमिकों की इन दक्षताओं में से प्रत्येक की मात्रा को मापा, जिन्हें साहित्य के माध्यम से पहचाना गया था। दक्षताओं के मापन के साथ ही साइटों पर प्रत्यक्ष अवलोकन के माध्यम से समान श्रमिकों की उत्पादकता को भी मापा गया। एकत्रित आंकड़ों (दक्षताओं और उत्पादकता) में विभिन्न सर्वोत्तम-फिट वक्र मॉडल लागू करके, प्रत्येक दक्षता और उत्पादकता के बीच सर्वोत्तम-फिट वक्र विकसित किए गए थे। इसके बाद, सभी दक्षताओं को व्याख्यात्मक चर और उत्पादकता पर निर्भर चर के रूप में एक प्रतिगमन मॉडल विकसित किया गया। तत्पश्चात, लेखक ने भारत में चार प्रशिक्षण केंद्रों का दौरा किया और समय-समय पर (90 दिनों के प्रशिक्षण के प्रत्येक 2 दिनों में) 137 प्रशिक्षु श्रमिकों की सभी पहचान की गई क्षमताओं को मापा। श्रमिकों के दक्षताओं के इस आवधिक डेटा को उनके प्रशिक्षण के दौरान उनके प्रदर्शन में वृद्धि की गणना करने के लिए विकसित प्रतिगमन मॉडल में डाला गया। इसके बाद, श्रमिकों

के प्रदर्शन में वृद्धि और उनके प्रशिक्षण समय के बीच एक सीखने का वक्र बनाया गया। इसके अलावा, दक्षताओं तथा प्रशिक्षण समय के बीच में भी वक्रों को यह समझने के लिए तैयार किया गया कि उनके प्रशिक्षण के दौरान श्रमिकों की क्षमता कैसे बढ़ रही है।

परिणाम के अनुसार ये पता चलता हैं कि प्रशिक्षण के बाद श्रमिकों का प्रदर्शन नियोक्ताओं के वांछित स्तर से काफी नीचे था; इसका कारण दक्षताओं बनाम प्रशिक्षण समय के वक्र से निकलता है, जहां यह पाया गया कि प्रशिक्षण सामाजिक-संज्ञानात्मक और संज्ञानात्मक दक्षताओं को बढ़ाने पर ध्यान केंद्रित नहीं करता है। इसलिए, अध्ययन अनुशंसा करता है कि प्रशिक्षण प्रदाता प्रशिक्षण से अधिक वांछनीय आउटपुट प्राप्त करने के लिए प्रशिक्षण पाठ्यक्रम में इन दक्षताओं को शामिल किया जाना चाहिए। यह एक प्रभावी श्रमिक प्रशिक्षण कार्यक्रम को डिजाइन और कार्यान्वित करने में मदद करेगा।

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LIST OF ABBREVIATION

BA	Behavioral Attributes
CSDC	Construction Skill Development Council
SD	Standard Deviation
CLP	Construction Labor Productivity
GATB	General Aptitude Test Battery
NGSE	New General Self-Efficacy Scale
NOS	National Occupation Standards
WHO	World Health Organization
BMI	Body Mass Index
SPSS	Statistical Package for the Social Sciences
TRA	Theory of Reasoned Action
TPB	Theory of Planned Behavior
BIM	Building Information Modelling