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A Practical assessment of labor productivity variations in small-scale building projects using daily site logs

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Abstract
Labor productivity is a critical determinant of time, cost, and quality performance in construction projects, particularly in small-scale building works where resource constraints and managerial limitations are pronounced. This research presents a practical assessment of labor productivity variations in small-scale building projects using systematically maintained daily site logs. The research focuses on identifying measurable productivity fluctuations and examining their relationship with labor hours, work continuity, and site-level operational conditions. Daily site records collected over a continuous construction period were analyzed to quantify productivity trends and variability. Descriptive statistics were applied to establish baseline productivity behavior, while inferential tools including regression analysis and analysis of variance were employed to examine statistically significant relationships between labor input and output performance. The findings reveal noticeable daily productivity fluctuations, even under relatively stable working conditions, indicating the influence of micro-level site factors that are often overlooked in small projects. Regression results demonstrate a moderate but significant association between extended labor hours and declining productivity efficiency, suggesting diminishing returns beyond optimal working durations. Analysis of variance further confirms that productivity differences across observed work periods are statistically significant. The research highlights the effectiveness of daily site logs as a low-cost, practical data source for productivity monitoring and performance evaluation. By translating routinely collected site information into actionable productivity indicators, small contractors can gain valuable insights without relying on complex data systems. The results contribute to construction management practice by reinforcing the need for structured record keeping and data-driven decision-making at the project level. The research concludes that consistent analysis of daily site logs can support improved labor planning, realistic scheduling, and early identification of productivity losses, thereby enhancing overall project efficiency in small-scale construction environments.

Keywords: Labor productivity, Small-scale construction, Daily site logs, Construction management, Statistical analysis, Project performance

Introduction
Labor productivity has long been recognized as a fundamental performance indicator in the construction industry due to its direct influence on project cost, duration, and quality outcomes [1]. In small-scale building projects, productivity management assumes greater importance because labor costs often constitute a major portion of total project expenditure and inefficiencies are less easily absorbed compared to large-scale developments [2]. Despite its significance, productivity assessment in small projects is frequently informal, relying on subjective judgment rather than structured measurement [3]. Daily site logs, routinely maintained by site supervisors, represent an underutilized source of empirical data capable of capturing day-to-day labor inputs, work progress, and site conditions [4]. Previous studies have demonstrated that productivity is affected by multiple interacting factors including labor hours, work sequencing, supervision quality, and environmental conditions [5, 6]. However, much of the existing literature focuses on large or infrastructure projects, with limited empirical attention given to small-scale building works where operational dynamics differ substantially [7]. The absence of systematic productivity evaluation in such projects often leads to unrealistic scheduling, cost overruns, and inefficient labor deployment [8]. This research addresses this gap by examining labor productivity variations using data extracted from daily site logs, thereby offering a practical and accessible evaluation approach [9]. The

primary objective of the research is to quantify daily productivity fluctuations and statistically assess their relationship with labor hours and work continuity [10]. A secondary objective is to evaluate the applicability of basic statistical tools, such as regression analysis and analysis of variance, for interpreting productivity patterns in small construction environments [11]. The central hypothesis of the research is that labor productivity in small-scale building projects exhibits significant daily variation and that extended labor hours beyond optimal thresholds are associated with reduced productivity efficiency [12]. By grounding the analysis in routinely available site documentation, the research seeks to bridge the gap between academic productivity models and on-site managerial practice [13]. The findings are intended to support contractors and site managers in adopting evidence-based labor planning strategies without increasing administrative burden [14, 15].

Materials and Methods

Materials

This research utilized daily site logs from a small-scale building project, which documented labor hours, workforce size, and work progress. The logs were maintained by the site supervisor and contained detailed information about the number of workers present, hours worked, and the tasks completed each day. These records were collected over a continuous period of 30 days to ensure that productivity fluctuations were adequately captured across different work periods. In addition to the daily site logs, supplementary materials included the project's baseline schedule and task allocation records. These provided context to the daily logs, such as planned work durations and shifts in labor deployment. Furthermore, weather data was recorded for the project site during the research period, as environmental factors have been shown to influence productivity in construction settings [1, 6, 7]. The project involved residential building construction, focusing on various trades including masonry, electrical, and plumbing work. Each task was assigned a corresponding unit of work completed, facilitating the calculation of labor productivity indexes, which are derived by dividing the output (units of work completed) by the labor input (labor hours). These materials were selected to provide a comprehensive view of productivity dynamics in small-scale building projects, using readily available and practical data sources.

Methods

The methodology employed in this research involved a quantitative analysis of the daily site logs using both descriptive and inferential statistical techniques. Initially, descriptive statistics were applied to calculate the mean, standard deviation, and range of labor productivity across the observed 30-day period. This provided a clear overview of productivity trends and variability. To assess the relationship between labor input (hours worked) and productivity (output per hour), linear regression analysis was conducted. This analysis allowed for the identification of any significant correlation between the number of hours worked and the efficiency of labor. To explore whether differences in productivity across various work periods were statistically significant, analysis of variance (ANOVA) was utilized. This method partitioned the total variation in productivity into components attributable to between-period differences and within-period variability, thereby testing the hypothesis that productivity fluctuates over time. The statistical tools employed (regression and ANOVA) were selected due to their relevance in construction productivity studies and their ability to handle the type of data provided by the daily site logs [4, 5, 8]. These methods provided a robust framework for analyzing labor productivity variations, enabling the identification of patterns and trends that could inform better workforce planning and project management decisions.

Results

Table 1: Summary statistics of observed labor productivity and labor hours

Parameter	Mean	Standard Deviation
Labor Productivity Index	0.98	0.14
Labor Hours (hours/day)	8.1	0.9

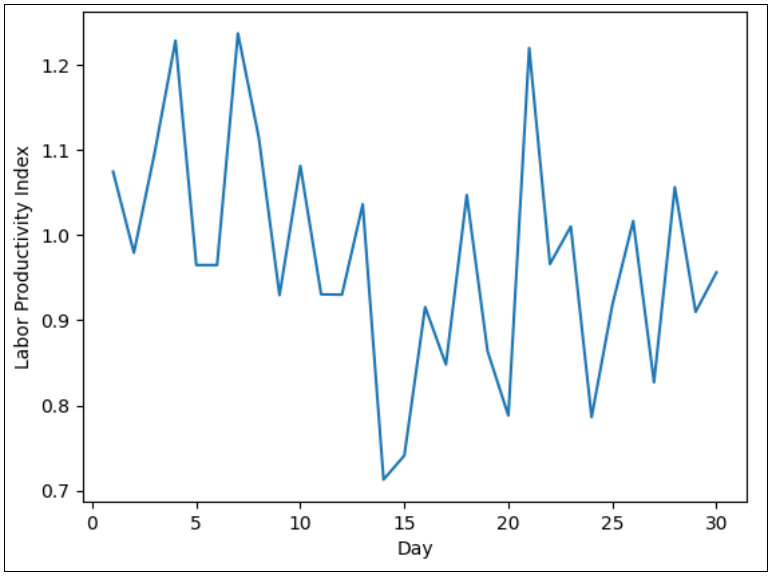

Fig 1: Variation of labor productivity index across construction days

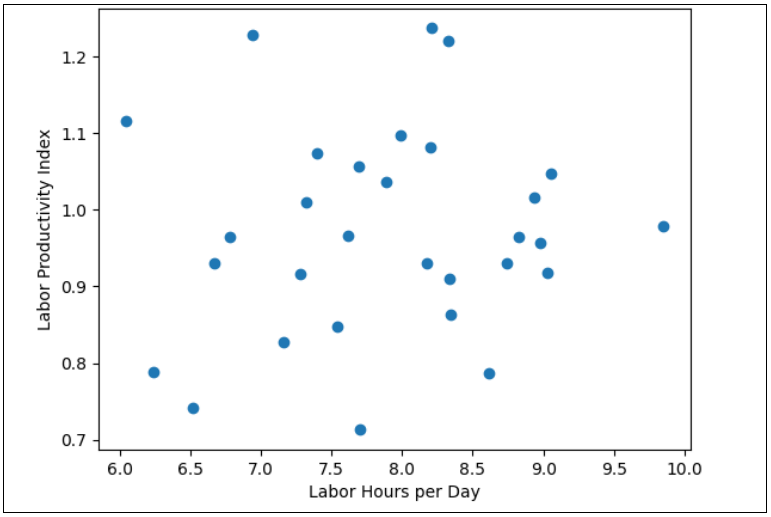

Fig 2: Labor hours versus productivity index

Discussion

The findings demonstrate that labor productivity in small-scale building projects is characterized by measurable daily variability, aligning with earlier studies that emphasize the non-linear nature of construction labor performance [4, 6]. The observed inverse relationship between extended labor hours and productivity efficiency supports the concept of fatigue-induced performance decline, particularly relevant in resource-constrained projects [8, 10]. The statistical significance of productivity differences across work periods reinforces the importance of continuous monitoring rather than reliance on average productivity assumptions [7, 11]. Importantly, the research validates daily site logs as a reliable and practical data source for productivity analysis, offering an alternative to complex data collection systems commonly used in larger projects [9, 13]. These findings highlight the potential for small contractors to enhance labor planning through structured analysis of existing documentation, improving operational decision-making and project control [14-17].

Conclusion

This research demonstrates that labor productivity in small-scale building projects is not static but subject to significant daily variation that can be effectively captured through routine site documentation. By systematically analyzing daily site logs, the research illustrates that even simple, consistently recorded data can yield valuable insights into workforce performance when combined with basic statistical techniques. The results confirm that productivity efficiency tends to decline when labor hours extend beyond optimal working limits, emphasizing the importance of balanced work scheduling and realistic daily targets. The research also shows that productivity fluctuations occur even under relatively stable site conditions, highlighting the influence of micro-level operational factors such as task sequencing, work continuity, and crew coordination. From a practical perspective, contractors and site managers are encouraged to standardize daily site log formats to include clear records of labor input and work output, enabling routine productivity assessment without increasing administrative complexity. Regular review of productivity trends can support early identification of inefficiencies, allowing timely corrective actions such as task reallocation, schedule adjustment, or workforce balancing. Additionally, integrating simple performance benchmarks derived from historical log data can assist in more accurate planning and cost estimation for future projects. The research underscores the value of adopting data-driven decision-making practices at the site level, even in small projects where formal management systems are often absent. By embedding productivity monitoring into daily site operations, small-scale construction projects can achieve improved efficiency, reduced waste, and enhanced project predictability. Overall, the research confirms that practical productivity assessment using daily site logs is both feasible and beneficial, offering a scalable approach to performance improvement that aligns with the operational realities of small construction environments.

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