

Improving the Crew Productivity and Projects' Performance for the Construction of Steel Structure Projects

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Abstract: Nowadays, steel structures are playing an important role and constructed worldwide for a variety of functions in different environmental conditions. Steel structural projects are a relatively special field of construction projects which is concerned with the design and installation of different project elements according to various purposes. The steel structure projects differ from conventional structural engineering projects mainly in the special problems that have to be considered during construction, transportation, installation and operation. The crew productivity improvements are attributed to the technology advances in equipment and construction methods over the last two decades. There are many factors that impact the crew productivity in this field. For every project, productivity, cost, quality and time have been the main concern. The purpose of the study discussed in this paper is improving the crew productivity and projects' performance for the construction of steel structure projects. The research was conducted by Personal interviews, Literature Review, Researchers knowledge, telephone calls and correspondence via an Email. The construction industry can use the findings in this paper as a basis for improving the crew productivity and projects' performance for the construction of steel structure projects. It was designed model on Matlab in measuring and evaluation the crew productivity of Construction of Steel Structure projects for Construction process of Steel Structure based on the several factors that affect the steel structure process. It is recommended that contracting and consulting firms to improve the crew productivity and projects performance for the construction of steel structure projects before starting and during the construction of projects.

Key words: Productivity • Steel structures • Projects performance • Construction management • Project management • Construction productivity

INTRODUCTION

Although steel structural projects are a relatively special field of construction projects which is concerned with the design and installation of different project elements according to various purposes. Improve productivity leads to saving a lot of time and costs in the steel structure projects, but the most discussions at this point did not pay attention to improving crew as a whole, but research in general about the productivity in construction projects only and some of them discussed the improvement of labor productivity only, despite the fact that crew in this type of project labor is less expensive than the equipment and tools and these projects depend mainly on the equipment and tools in addition to the labors. Studying of factors that affecting

on Productivity for sixty researches (Fig. 1). Analysis of Factors Influencing Productivity in Central Gujarat Region in India identified and ranked the key factors affecting the project level productivity [1]. Analysis of labour productivity of road construction in Pakistan, carried out to identify the critical factors which are responsible for poor labour productivity of road construction in Pakistan by questionnaire based survey [2]. Factors were studied affecting construction labour productivity in Trinidad and Tobago, a questionnaire was used to gather the relevant data from members of the Trinidad and Tobago Contractors Association and recommendations have been made in the study to address these factors [3]. Identified factors affecting labor productivity at a building construction project by a literature review and factors recommended by experts were considered to categorize

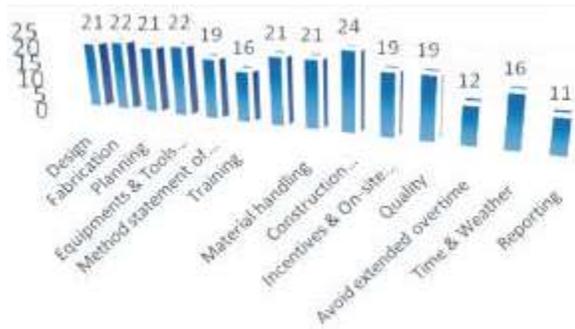


Fig. 1: Percentage studying of factors that affecting on Productivity for 60 researches

the factors and categorized factors into five groups, were analyzed and ranked considering relative importance index (RII) by the questionnaires. It was concluded, final cost of the projects were higher than estimated cost [4]. It was studied improving construction labor productivity and projects' performance. It can help improve the overall performance of construction projects through the implementation of the concept of benchmarks [5]. Studying the relationship between working at height and productivity for masonry and concluded that the six major factors affecting on productivity [6]. The factors effect on construction industry productivity was reviewed by a structured questionnaire and he ranked factors to primary and secondary factors as perceived by the project managers who were surveyed [7]. Studying that included direct observation of steel erection activities and statistical analysis of task duration data. The data collected at steel erection sites included safety conditions such as the use of personal protective equipment PPE, elevation of the work area, environmental conditions such as temperature and humidity and worker performance in the form of task durations. Analysis of variance analysis of 186 of steel erection task durations collected over a six-month period showed that the use of personal protective equipment (PPE), the time of day during which the operation was being performed, the elevation at which the work was being performed and the presence of decking below the work area had statistically significant effects on the durations of steel erection tasks [8]. Studying the impact of equipment technology on labor Productivity in the U.S. construction industry [9]. It is identify factors affecting crew productivity and projects' performance for the Construction of Steel Structure projects. At present there are no universally accepted standards to measure factors affecting on crew productivity in construction industry especially construction of steel structure projects. Factors of similar nature were grouped together;

giving rise to 15 main groups arranged in excel sheet and divided to pre-construction process and during construction process.

The Effect of Design and Fabrication on Productivity and Projects Performance

Design: Design is the starting point in any project, the integration between the design and construction phases will result in greater crew productivity as construction considerations are taken into account at the design stage. Designers of steel structures should be aware not only with design process requirements for the structures but also with fabrication and erection methods to ensure that a steel Structure design can be safely, economically and reliably executed (fabricated, assembled and erected), these may determine whether a design is practical and cost efficient (design for construction). There are two separate phases of design:

Structural Design: The structural steel design should be produced according to Construction Management of Steel Construction and code of steel structures, Guidelines for the erection of building steelwork, which detail how risks can be eliminated or reduced in the design stage and helping for improving the crew productivity and projects performance.

Design for Erection: The second phase, the design for erection, is for the handling, transportation and erection of the individual members and structure. It may be produced independently of the structural design of the building. Ideally, planning for the safe erection of structural steel work should be considered at the design stage. Structural design engineers should consider the safe working conditions for those involved in the erection stage and eliminate as many of the hazards as possible at this stage and improving the crew productivity and projects performance.

Fabrication: Fabrication is the process used to manufacture steel structures components that will, when assembled and joined, form a complete frame. The frame generally uses readily available standard sections that are purchased from the steelmaker or steel stockholder, together with such items as protective coatings and bolts from other specialist suppliers. Fabrication involves handling of the stock members, cutting them to size, punching and drilling for connections and preparing the connections, as well as shop painting or finishes when required.

Steel Structure Process

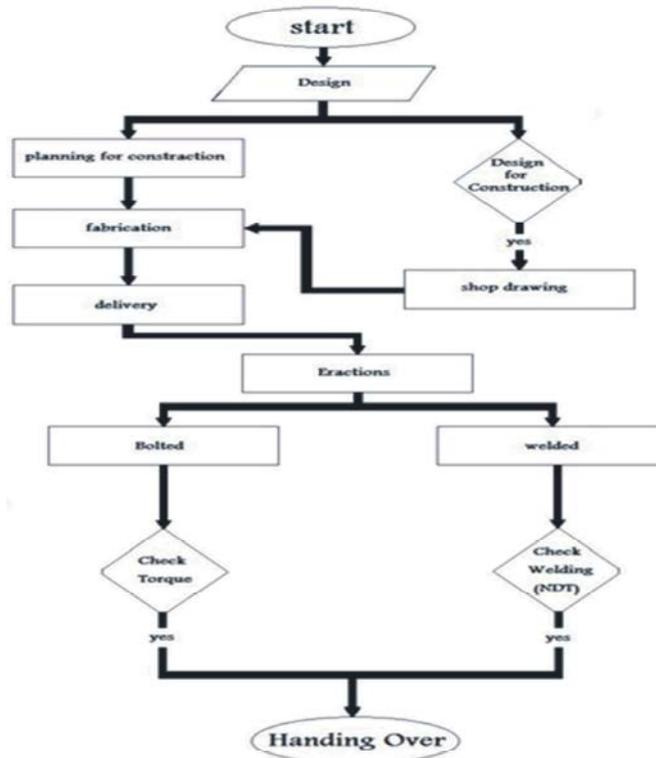


Fig. 2: Flow Chart Showing Steel Structure Process

The Principal Activities at the Fabrication Works:

- Pre-assembly butt welding
- Cutting and profiling
- Drilling and edge preparation
- Assembly
- Welding
- Fitting of stiffeners
- Shear connectors
- Trial erection (rarely carried out)
- Coating application

Fabrication Considerations: There are many factors that must be considered during the fabrication and have a great impact on improving the crew productivity and projects' performance for the Construction of Steel Structure projects:

- Accuracy
- Handling and transportation
- Shortage materials
- Damaged or defective material

- Delivery priority
- Schedule time for fabrication

The Improvement of the Crew Productivity: Improving construction productivity is a complex subject. There are many factors that impact productivity in this field.

Erection Stages: Steel erection is conducted by the steel erector, some fabricators may have their own erection crews or subsidiary companies; others will subcontract this work to a separate erection company, there must be a continuous strong link between erection and fabrication. For applying this model on program (Fig. 2), using (Wamp Server for login and Netbeans for writing codes) – Programming language (PHP).It help consultants and the main contractors in the follow-up of the project since its start and through the various stages.

Factors for Improving the Crew Productivity: There are many factors that are involved with crew productivity improvements, it is not an easy mode to follow and it needs commitment of the highest level to achieve real

improvements. Many companies are increasing their capacity to produce more, but there is a huge need to improve crew productivity. Many researchers have studied some of the factors that effect on construction productivity.

Analytical Model: The data collection process used in this research had the option of basic methods: Personal interviews, Literature Review, Researchers' knowledge, telephone calls and Correspondence *via* an Email. Data was collected from literature reviews from books, journals, articles, seminar conferences and websites which emphasize construction productivity for 14 factors and it was collected from Personal interviews for assemble process which were identified Rii ($a_{i,s}$) for the assembly process valued 0.7.

Defining the Factors Affecting Crew Productivity and Resulting Model

Input Factors:

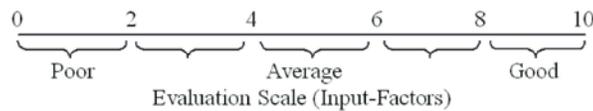
- Design;
- Fabrication;
- Planning;
- Equipment & Tools and technology;
- Method statement of construction;

- Training;
- A dependable supervisors;
- Material handling;
- Construction Health, Safety, Security and Environmental;
- Incentives & On-site services;
- Quality;
- Avoid extended overtimes;
- Time & Weather;
- Assemble process; and,
- Reporting

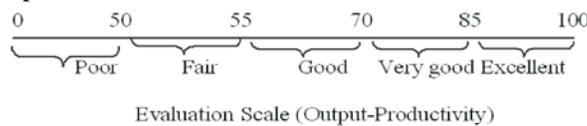
Output Factors: Productivity (Measuring, Evaluation and recommendations for crew productivity).

Level of Measurement: The Level of measurement for a factor are used to define the extent, which is defined between 0 and 10. The respondents will provide with a range of values or ratings (such as 0 to 10 descriptors (0=poor, 5=average, 10=good)) that describe factors that effect on crew productivity.

Level of Measurement for Input: Numerical values or subjective values (on a scale of zero to 10) such as 0 to 10 descriptors (0=poor, 5=average, 10=good) [10].



Level of Measurement for Output:



Construction of Level of measurement was primarily based on information elicited from structured questionnaires that were completed by experts in previous studied.

Model Formulation: The model can be summarized as:

$$Y = (0.725 \times X_1 + 0.738 \times X_2 + 0.715 \times X_3 + 0.636 \times X_4 + 0.682 \times X_5 + 0.633 \times X_6 + 0.717 \times X_7 + 0.723 \times X_8 + 0.618 \times X_9 + 0.611 \times X_{10} + 0.764 \times X_{11} + 0.625 \times X_{12} + 0.711 \times X_{13} + 0.7 \times X_{14} + 0.7 \times X_{15}) \times \left(\frac{100}{103}\right)$$

Such that;

Y is Productivity, X_1 is Design, X_2 is Fabrication, X_3 is Planning, X_4 is equipments & tools and technology, X_5 is method statement of construction, X_6 is training, X_7 is a dependable supervisors, X_8 is Material handling, X_9 is Construction Health, Safety, Security and Environmental, X_{10} is Incentives & On – site services, X_{11} is Quality, X_{12} is Avoid extended overtime, X_{13} is Time & Weather, X_{14} is Reporting and X_{15} is Assemble process .

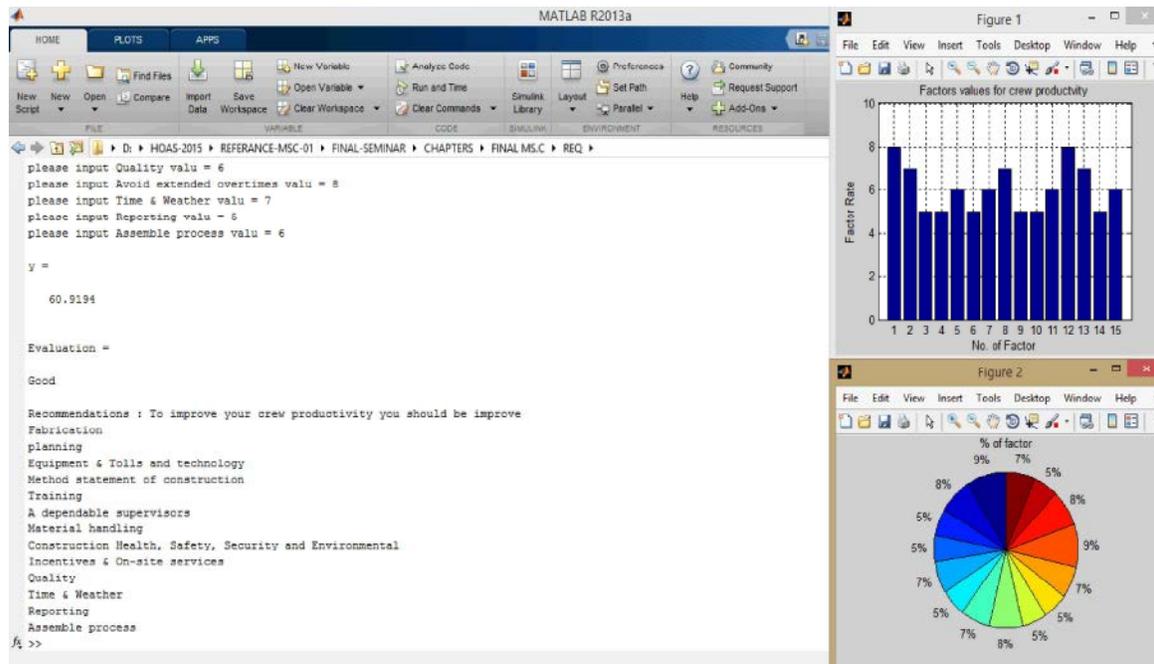


Fig. 3: Model for testing project

Validation for Model: The model was verified through testing on three constructions of steel Structure projects. The results show that it is easy to use and useful as a tool for measuring and evaluation the crew productivity of construction of steel structure projects (Fig. 3).

CONCLUSION

The research studies improving the crew productivity and projects' performance for the construction of steel structure projects. Using Matlab model for measuring and evaluation the crew productivity of construction of steel structure projects. The model was verified through testing on three steel structure projects. The results show that the model is easy to use and useful as a tool for measuring and evaluation the crew productivity of construction of steel structure projects. The main contribution of this research is in for improving the crew productivity and projects' performance for the construction of steel structure projects, study the factors for improve the crew productivity and projects' performance for construction and erection Steel Structure projects such as planning, time, quality, ...etc. Using model on Matlab in measuring and evaluation the crew productivity of construction of steel structure projects for construction process of Steel Structure based on the several factors that affect the steel structure process. Using these techniques to model objective and subjective

data that were extracted from an actual crew productivity study. Since the data collected in the crew productivity study represent the type of data that would be available within organizations, this research demonstrates how such data can be used for improving, measuring and evaluation the crew productivity of construction of steel structure projects for construction process of Steel Structure based on the several factors that affect the steel structure process.

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