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A Review on Affecting Labour Productivity at a Building Construction Project by Web Survey

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Abstract: Construction projects suffer various problems and complex factors such as cost, duration, quality and safety. Construction sector is diverse as it contains contractors, consultants, designers, owners, and others. The aim of this paper is to identify factors affecting labour productivity at a building construction project. A literature review and factors recommended by experts were considered to categorize the factors. 40 factors, categorized into 5 groups, were analysed and ranked considering Relative Importance Index. The questionnaires were distributed to Project Manager, Project Engineer, Architecture, and Others (Scheduler, and Estimator). It was concluded, final cost of the projects were higher than estimated cost. It's recommended to develop human resources through proper and continuous training programs frame a strong assignment, vision and a planned approach to overcome the disturbances on the performance of the construction projects. The discussed factors are expected to assist in completing construction projects successfully.

Keywords: Building Construction Projects, Construction Industry, Project Engineer

I. INTRODUCTION TO THE STUDY

A. Introduction

Several studies related to labour productivity are performed for construction industry in past. Several of them were related to calculating the effect of productivity factors. Measureable calculations about the effects of those factors are required for several purposes, it includes estimation of the construction project, it's planning and scheduling. However, past study shows that it is tough to calculate such an impact, and at present there are no universally accepted standards to measure factors causing labour productivity loss in construction industry. This lack of methods for measuring effects highlights the need to enhance measureable assessments for the factors affecting productivity in building construction, and this is supposed to be the topic of this research. Achieving better labour productivity requires detailed studies of the actual labour cost. Various labour s have different variables affecting their productivity levels. For every project, productivity, cost, quality, and time have been the main concern. Better productivity can be achieved if project management includes the skills of education and training, the work method, personal health, motivational factors, the type of tools, machines, required equipment and materials, personal skills, the workload to be executed, expected work quality, work location, the type of work to be done, and supervisory personnel (Rowlinson and Proctor, 1999). In today's era, one of the biggest concern for any organization is to improve their productivity, representing the effective and efficient conversion of resources into marketable products and determining business profitability (Wilcox et al., 2000). Consequently, considerable effort has been directed to understand the productivity concept with different approaches taken by researchers, resulting in a wide variety of productivity definitions (Lema and Samson, 1995; Oglesby et al., 2002; Pilcher, 1997).

B. Background About Productivity

Productivity is generally defined as the average direct labour hours required to install a unit of material. It is said that perfect productivity (1.0) can be achieved with a 40-hour work week, with people taking all the holidays and vacation days as planned all of the engineering drawings would be 100% complete there would be no delays of any kind during construction; everyone would work safely; everything would fit perfectly the first time; the weather would be 70° F; and there would be no litigation at the end of the project (Rowlinson and Proctor, 1999).

C. Critical Success Factor Criteria

The term "productivity" expresses the relationship between outputs and inputs (Borcherding and Liou, 1986). Output and input differ from one industry to another. Also, the productivity definition varies when applied to different areas of the same industry. Labour is one of the basic requirements in the construction industry. Labour productivity usually relates manpower in terms of labour cost to the quantity of outputs produced (Borcherding and Liou, 1986). In other words, the definition of labour productivity is the amount of goods and services produced by a productive factor (manpower) in the unit of time (Drewin, 1982).

In 1883, Littre defined productivity as the "faculty to produce," that is, the desire to produce (Jarkas, 2005). In 1950, the Organization for European Economic Cooperation (OEEC) introduced the definition of productivity as a quotient obtained by dividing the output by one of the production factors (Sumanth, 1984). Depending on measurement objectives and the availability of data, several productivity definitions are encountered. The U.S. Department of Commerce defined productivity as "dollars of output per person-hour of labour input" (Adrian, 1987).

D. Significance Of Productivity

Productivity has a great significance in construction. Labour productivity constitutes a significant part of production input for construction projects. In the construction industry, many external and internal factors are never constant and are difficult to anticipate. This factor leads to a continuous variation in labour productivity. It is necessary to make sure that a reduction in productivity does not affect the plan and schedule of the work and does not cause delays. The consequences of these delays could result in serious money losses. Further, considerable cost can be saved if productivity is improved because the same work can be done with less manpower, thus reducing overall labour cost (Thomas, 1991).

E. Problem Statement

In the construction industry productivity loss is one of the greatest and severe problems. Present construction contracts lack enough to classify recompense for productivity loss due to field factors (Construction Industry Institute [CII], 2000; National Electrical Contractors Association [NECA], 1989). Of various project-costs components such as labour s materials and equipment's, labour component is considered the most risk. Whereas others components (equipment and material) are determined by the market price and price and are, consequently, beyond the influence of project management. Labour cost in construction industry is estimated to be about 33%- 50% of the entire project cost (language Hanna et al., 2005). Because labour is more variable and unpredictable than other project-cost components, it becomes necessary to understand the effects of different factors on labour productivity. An increase in productivity can reduce the labour cost in a direct proportion. It can either benefit or reduce a project's profit, making it of vital interest to the construction industry for its success (Hanna et al., 2005).

Previous researches confirm that productivity loss results from various factors, which includes but not limited to various variation in drawings, long hours of extra work, poor field management, and extreme climatic conditions (Alarcon and Borcherding, 1991; Leonard, 1987; Sanders and Thomas, 1991; Thomas and Oloufa, 1995). In fact, these factors typically produce extra disturbances that affect productivity and are beyond the direct control of a contractor, resulting in productivity loss or extra work hours necessary to accomplish the task.

II. LITERATURE REVIEW

Increase of productivity was calculated prior to mid-1906's, in the construction industry (Stall, 1983). Later, decline in productivity has remained of great concern issue in the construction industry all over the world. In 1968, the Construction Roundtable was established due to concern about the increased cost of construction resulting from an increase in the inflation rate and a significant decline in construction productivity (Thomas and Kramer, 1988). Also in 1965, the United Nations Committee on Housing, Building, and Planning (UNC) published a significant manual concerning the effect of repetition on building operations and processes (UNC, 1965). The research discovered the necessity for a rise in productivity was perhaps more severe in the construction sector compared to any other sector. It was necessary to implement, as far as possible, industry-wide principles of production throughout the construction process. Though, it was known that careful adaptation would be required to implement the knowledge and experience gained in the manufacturing industry to the building construction industry (Alarcon and Borcherding 1991). Past studies and research show the number of factors affecting productivity, there are still anonymous factors need to be further studied even in developed countries (Makulsawatudom and Emsley 2002). A study by (Polat and Arditi 2005) stated that policies to rise productivity are not always similar in each country. Their study identified different factors affecting labour productivity and grouped them according to their characteristics such as, design, execution plan, material, equipment, labour , health and safety, supervision, working time, project factor, quality, leadership and coordination, organization, owner/consultant, and external factors. (Adrian, 1987) Classified the productivity factors causing low productivity as industry-related factors, labour -related factors, and management-related factors. Industry-related factors, essentially, are the characteristics of the construction industry, such as the uniqueness of construction projects, varied locations, adverse and unpredictable weather, and seasonality. Labour -related factors include the union's influence, little potential for learning, and lack of motivation. Management-related factors usually refer to a lack of management for tools or techniques.

(Olomolaiye et al. 1998) Classified the productivity factors into two categories: external factors the ones outside the control of the organization management and internal factors related to the productivity factors originating within the organization. From their viewpoint, the nature of the industry, usually the separation of design and construction functions, has affected construction productivity through delay in drawings, design changes, and following rework. Construction clients have sometimes been obstructions to construction productivity because of their lack of suitable knowledge about construction procedures. Moreover, being an outdoor industry, construction performance is extremely affected by weather conditions. In addition to the factors disused, health and safety regulations, and codes of practices are other external factors influencing task operations and productivity. In the internal category, management inadequacies could result in a waste of resources with consequent losses in productivity; adoption of modern technology and training for the labour er would increase productivity.

(Thomas and Sakarcan 1994) Built an ideal to describe the factors affecting labour productivity. In the model, two groups of factors determine the productivity performance, work environment, and task to perform. Work-environment factors refer to how well a job is organized and accomplished. Work to be done, or work content, relates to work required to perform and includes physical components of work, specification requirements, and design details.

Past study showed that task to be completed could affect the labour resources by as much as 15%, whereas work environment can affect labour requirements by an extra 25%. Based on this factor model, more detailed research was done. One study suggested that scheduled overtime always leads to efficiency losses because of the inability to deliver materials, tools, equipment, and information at an accelerated rate (Ginther, 1993). Surveys and interviews are standard methods that have already been adopted in many productivity studies. (Lim and Alum 1995) Conducted a survey of top construction contractors to identify the factors affecting productivity in Singapore. The three items of extreme concern were identified as difficulty in the recruitment of supervisors, difficulty in the recruitment of labour s, and a high rate of labour turnover. (Portas and AbouRizk 1997) undertook a questionnaire of superintendents and project managers to determine all possible factors affecting productivity. An interview conducted with contractors showed that weather and material delivery were the main adverse factors for site productivity (Hassanein and Melin, 1997). A questionnaire identified rework, material problems, tools, heavy-equipment availability, crew interference, overcrowded work areas, instruction, quality-control inspection, and management interventions as the main factors affecting craftsman productivity and motivation (Chang and Borcherding, 1985).

Another survey with construction personnel (Hanna and Heale, 1994) was conducted to gauge their opinion about the field of construction, specifically their knowledge about the factors that most affect construction productivity. As a result, a set of comprehensive factors was identified and classified into six groups: contract environment, planning, site management, working conditions, working hours, and motivation.

III.RESEARCH METHODOLOGY

"Survey research is defined as collection of different data by asking people questions" (Fowler, 1993). The data collection process used in this research had the option of two basic methods: questionnaires and personal interviews. A questionnaire was preferred as the best effective and suitable data-collection technique for the study. It was concluded that the questionnaire was described as a self-administered tool with web-design questions, an appropriate response.

A questionnaire in a web-survey format comparatively requires less duration and saves cost for the researcher while permits respondents to response the questionnaire at their personal ease. However, for this approach the reply rate is usually lower as compared to face-to-face interviews. Data was collected from literature reviews from books, journals, articles, seminar conferences, and websites which emphasize building construction's labour productivity. A survey was given to employees from different trades involved with the construction project.

A. Survey Planning

For the research study, email technology was used to send the survey questionnaire. Collecting general information on various factors affecting labour productivity in building construction all over USA was the basic aim of the survey. The purpose and approach used in the survey was fully explained to the respondents. Guidelines were provided to the respondents to ensure that the procedure was followed properly to reduce errors. During the survey period, some oversights were provided to help ensure the process was going smoothly and consistently. The data were stored in order to maintain confidentiality, and the output was received from the Group Discussion Center (GDC) in the form of electronic mail, which included raw data sheets, summary sheets, and computer databases. Results included the overall statistics as well as individual statistics.

B. Considerations for the Survey

The main consideration for a survey was that it should be easy for respondents. If questions are too complicated, possibility of high drop-out rate was studied. Care was taken so that the initial questions did not negatively influence the results of subsequent questions. Preliminary text was introduced for explaining the survey project to the respondents. Page breaks on the web pages were introduced to improve the text readability. Logic-based questions were avoided because they could cause respondent frustration and increase the drop-out rate. Study was done to find any serious loopholes and if questions were truly answerable.

C. Organization of the Questionnaire

One of the biggest concern of the research study was about number of responses with complete information. Recognition of respondents about the benefits and uses of this research study was also of great concern. Following criteria was used to begin the questionnaire design process:

Questionnaire	Response Rate
Exactness	Duration
Applicable	Ease of Completion
Completeness	
Understanding	

Carefulness and productivity were achieved by examining the accuracy and completeness of the related questions, taking into consideration the previous studies and Table 2.1. Even tough, great measures were taken to make the questionnaire efficient, it was however not assured that the response will be of high percentage. Great care was taken to assure respondents get precise duration to respond to the survey questionnaire and turn in to the researcher online. Considering the length, importance, sensitivity, past experience of researcher's advisor and feedback collected from pilot survey it was decided, the average time to complete the whole survey questionnaire would require about 15 minutes. Duration of 6 weeks was assigned to complete and submit the survey questionnaire. Questionnaire were kept effective and simple for the respondents. Various sections were designed for the survey questionnaire and they were assigned distinct colors for appropriate responding.

D. Questionnaire

The questionnaire design practice advanced on a communicating basis. It was categorized into profile of the respondent and various factors affecting labour productivity in building construction. Questions in the respondent profile were created to collect information such as job position, experience of the work, locations of the current and/or previous works and contact information. It was studied, these questions in the survey were of great important to the research by analyzing productivity loss concerns from a variety of different profiles from different regions. It was practical to anticipate that a location can have an impact on the loss of productivity due to various field disturbances, especially geographical and climatic conditions.

The next set of questions (Appendix B), was targeting the factors affecting labour productivity in the five different groups. It included factors affecting labour productivity. Respondents simply furnished of factors affecting productivity for given typical condition. Hence, each respondent had a choice to select only one option for each factor. The responses were to be based on the understanding, knowledge and experience of the respondents and not related to any definite project. This simple and straight method was selected to establish a means of developing a list of factors affecting labour productivity in building construction.

E. Pilot Survey and Questionnaire Revision

To improve the questionnaire section, a pilot study was accompanied. This section contained identification of different causes, collection, and conclusions of data.

The application of this section benefited in better formation of the web-survey development

Total 155 questionnaires, (shown in Table 2.2) were sent by e-mail to labourers, contractors, architectures, owners, project managers, and project engineers of various building construction organizations. It was expected to complete and submit the response within 2 weeks.

By the end of 2nd week, 25 responses collected from the pilot survey, 5 of those were incomplete and were removed from the set, leaving a total of 20 respondents in the database. Information obtained and the recommendations provided in from pilot survey are discussed below.

1) Questionnaire should always start with the general information of the organization
2) Some factors are not related to construction. They should be removed or modified.
3) To get more suitable and consistence meaning some factors should be rearranged.
4) Some factors should be revised with additional information.
5) Factors repeated with similar meaning should be removed.
6) Some factors should be changed to give clearer importance and understanding.

Better and accurate questionnaire related to the topic was achieved from the pilot study.

The perfections related to the organization of the questionnaire and the response time. In terms of organization, the web survey was created using a light appearance and pleasant-looking font colors. It also included a percentage bar for the completed survey and had an option to navigate to any question at any given time. All the information entered via the web had an auto-save option and the respondents had the luxury to return to the survey within the allotted duration. Respondents were informed about the confidentiality of the responses. The list of questions used for the web survey can be found in Appendix B.

F. Questionnaire Distributions

The target groups in this study were professionals from the construction industry. A list of 255 building-construction organizations was obtained from the *Engineering News-Record*. The sample size can be calculated with the following equation for a 94% confidence level (Al-Shahri, M et al., 2001; Israel, 2003; Moore et al., 2003):

$$n= n' / [1+ (n' / N)]$$

Where, n= Total number of population

N = Sample size from a finite population

n' = Sample size from an infinite population = S^2/V S^2 = the variance of the population elements and

V = a standard error of the sampling population. (Usually, S= 0.5, and V = 0.06.) n'=S^2/V^2= $(0.5)^2$+$(0.06)^2$= 69.44 For N=255

n = 69.44/ [1+ (69.44 / 255)] = 55

To obtain 94% of confidence level, it was calculated to send the questionnaire to 55 organizations to accomplish a 94%.

IV. ANALYSIS AND DISCUSSION OF RESULTS

A. Data Collected From The Web Survey

In successfully achieving main objective of the study, one of the most important phase is collection of accurate data. Data collection is a procedure of collecting crucial data records for a certain sample or population of observations (Bohrnstedt and Knoke, 1994). A total of 255 questionnaires were sent to construction professional through e-mail in early October 2009. By the due date, a total of 54 questionnaires were received, resulting in a nearly 21.17% reply rate (Table 3.1). Missing data frequently occur after the respondent chooses not to response a question or when the respondent rejects to answer the question. (Kim, 1993). The most serious concern presented in the responses was some missing data. Some of the unclear response was clarified over the phone. A total of 26 (i.e., 10.19%) invalid data received were deleted from research study. The reason to discard the data was incompleteness and invalid responses.

Table 4.1. Statistical Data of Questionnaires Sent and Received

	No.	Percentage of Total (%)
Total Questionnaires Sent	255.00	
Total Questionnaires Received	54.00	21.17
Invalid Data	26.00	10.19
Used for Study	28.00	11.00

B. Measurement of Data Collected from the Web Survey

It is commonly believed, while performing different task on construction projects, disturbances can existent with diverse degrees of danger. In order to overcome with these different degrees, it was decided to consider four condition levels: not applicable, does not affect it, somewhat affects it, and directly affects it. A clear specification of the standard conditions was necessary to enable respondents to clearly distinguish the degree of each adverse condition level. Standard conditions discussing to four different degrees of severity for each field were recognized by Dr. Eric Asa, Dr. Y. K. Yates, and the researcher. The concept of different degrees of severity for productivity factors was previously used in other studies (Mechanical Contractors of America 1976) and (Neil and Knack 1984). Slight modifications were made to the typical conditions after they were reviewed by the participants. Further, detailed questionnaire was developed to calculate the factors affecting labour productivity in building construction. In order to select the suitable technique of study, the level of measurement is to be studied. For each measurement type, there is (are) (an) appropriate method(s) that can be applied. In this research, ordinal scales were used. An ordinal scale, as shown in Table 3.2, is a ranking or a rating of data that normally uses integers in ascending or descending order. The numbers assigned (1, 2, 3, 4) neither indicate that the intervals between scales are equal, nor do they indicate absolute quantities. They are merely numerical labels. Based on a Likert scale, we have Table 3.2 (Cheung et al., 2004; Iyer and Jha, 2005; Ugwu and Haupt, 2007).

Table 4.2. Ordinal Scale Used for Data Measurement

Item	Not applicable	Does not affect it	Somewhat affects it	Directly affects it
Scale	1	2	3	4

C. Analysis Method Used

In order to facilitate the study, after the Literature Review and the focus interviews, a plan was formulated for collecting field information and creating an evaluation process and numerical values. It was necessary to provide straightforward communication to respondents to ensure a clear understanding of all the applicable definitions, procedures, and guidelines that were used in collecting data. Because the data-collection process included individuals, the study was conducted in accordance with the regulations of the Department of Health and Human Services, the Food and Drug Administration, and North Dakota State University (NDSU) Policy #345 under the supervision of the NDSU Institutional Review Board (IRB). Two different ways were used to analyze the survey results.

1) Ranking of the various factors according to their significance, and calculating their Relative Importance Index (RII)

2) Analyze the factors in the questionnaire are significant or non-significant.

The Relative Importance Index (RII) was used to decide various professionals' opinions of the RII in construction projects. RII is calculated as stated below (Cheung et al., 2004; Iyer and Jha, 2005; Ugwu and Haupt, 2007):

D. Size of Organization (Employees)

The average number of employees in an organization was 36. Only building construction projects were considered for the study.

E. Number of Projects per Year

The average number of construction projects undertaken per year was 3. Only building construction projects were considered for the study.

F. Type of Construction Projects

The type of construction organizations that responded is shown in Table 4.1. Only building construction project were considered.

Table 4.3. Types of Organizations that Responded

Construction Organizations	Respondents
Residential	6
Commercial	6
Industrial	5
Government	1
Engineering	2
Architecture	5
Owner	3

G. Job Title

Respondents' job titles are shown in Table 4.2. Various professional in building construction projects were contacted to gather the information from web-survey.

Table 4.4. Job Title of the Respondents

Job Title of the Respondents	Number of Respondents
Project Manager	4
Project Engineer	11
Architecture	3
Others (APM, APE, Scheduler, and Estimator)	10

H. Typical Size of Projects

The size of the projects in US$ (Million) undertaken by the respondents' companies is shown in Table 4.3. Only building construction projects were considered for the study.

Table 4.5. Typical Size of Projects

Typical Size of Project	No. of Projects
0-5 Millions	11
5-10 Millions	9
10-100 Millions	7
> 100 Millions	1

Research was performed considering, 40 factors affecting labour productivity for building construction were identified, and their RII was calculated. These factors were classified into five groups: manpower factors, external factors, communication factors, resources factors, and miscellaneous factors. Different groups used in the study are discussed in detail.

I. Manpower Factors Affecting Labour Productivity

Table 4.4 and Figure 4.1 shows the ranking of the various factors for the manpower group. A lack of labour experience was ranked first in the manpower group, with an RII value of 488.7, and twelfth among all 40 factors affecting labour productivity (Table 4.11). Lack of labour experience has a great influence on productivity. This result is supported by Paulson (1975) who found that the craftsmen's experience affects labour productivity. This conclusion is also supported by (Heizer and Render 1990) who established that the knowledge of the craftsman affects job-site productivity. This result is acceptable because experience improves both the intellectual and physical abilities of labour ers which, consequently, increases labour productivity.

Labour disloyalty had a great effect on labour productivity and ranked in the 7th position for the manpower group, with an importance index of 373.75, and 39th among all 40 factors in terms of negatively affecting labour productivity (Table 4.11).

Table 4.6. Manpower Factors

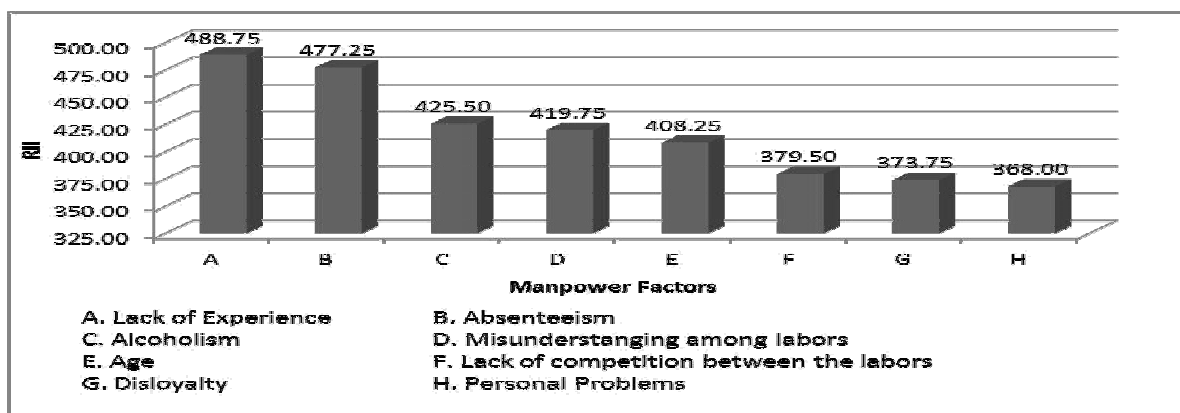| Factors	RII	Rank
Lack of experience	488.75	1
Absenteeism	477.25	2
Alcoholism	425.50	3
Misunderstanding among labour ers	419.75	4
Age	408.25	5
Lack of competition among the labour ers	379.50	6
Disloyalty	373.75	7
Personal problems	368.00	8

Figure 4.1. Manpower Factors.

Misunderstanding among labourers was ranked 4th in the manpower group, with an RII of 419.75, and 32nd among all 40 factors that affected labour productivity (Table 4.11). This result is acceptable because misunderstanding among labour ers can creates disagreement among them and about the responsibilities for each labour er, which leads to a lot of mistakes in work and, consequently, affects labour productivity. A lack of competition among labour ers ranked 6th, with an RII of 379.50, and ranked 38th among all 40 factors for negatively affecting labour productivity (Table 4.11.).

Labour s' age was ranked 5th in the manpower group, with an RII of 408.25, and 34th among all 40 factors that affected labour productivity (Table 4.11). (Heizer and Render 1990) supported this result, citing that the age factor generally affects job-site productivity. This result is justified because speed required to perform particular task and strength decline over time affecting labour productivity.

Labour absenteeism was ranked 2nd in the manpower group, with an RII of 477.25, and in 18th among all 40 factors that affect labour productivity (Table 4.11). This result is justified given the transient nature of the local workforce and the ease with which construction contractors could hire additional labour ers to cover absenteeism.

Personal problems were ranked 8th in the manpower group, with an RII of 368.00, and 40th among all 40 factors that affect labour productivity (Table 4.11). This result might be justified because personal problems cause mental disturbance for labourers, and thus can affect labour safety more than labour productivity.

Alcoholism ranked 3rd in the manpower group, with an RII of 425.50, and 30th among all 40 factors that affect labour productivity (Table 4.11). Consuming alcohol at the construction site may lead to various negative effects on other labourers who are working. Alcohol consumption may lead to rework, misplacing the job work, and accidents, thus completely or partially stopping the construction work and affecting labour productivity.

J. External Factors Affecting Labour Productivity
Table 4.5 and Figure 4.2 illustrate the ranking of factors for the external group. Supervision delays were ranked 1st in the external group, with an RII of 488, and 13th among all 40 factors that negatively affect labour productivity (Table 4.11).

Table 4.7. External Factors

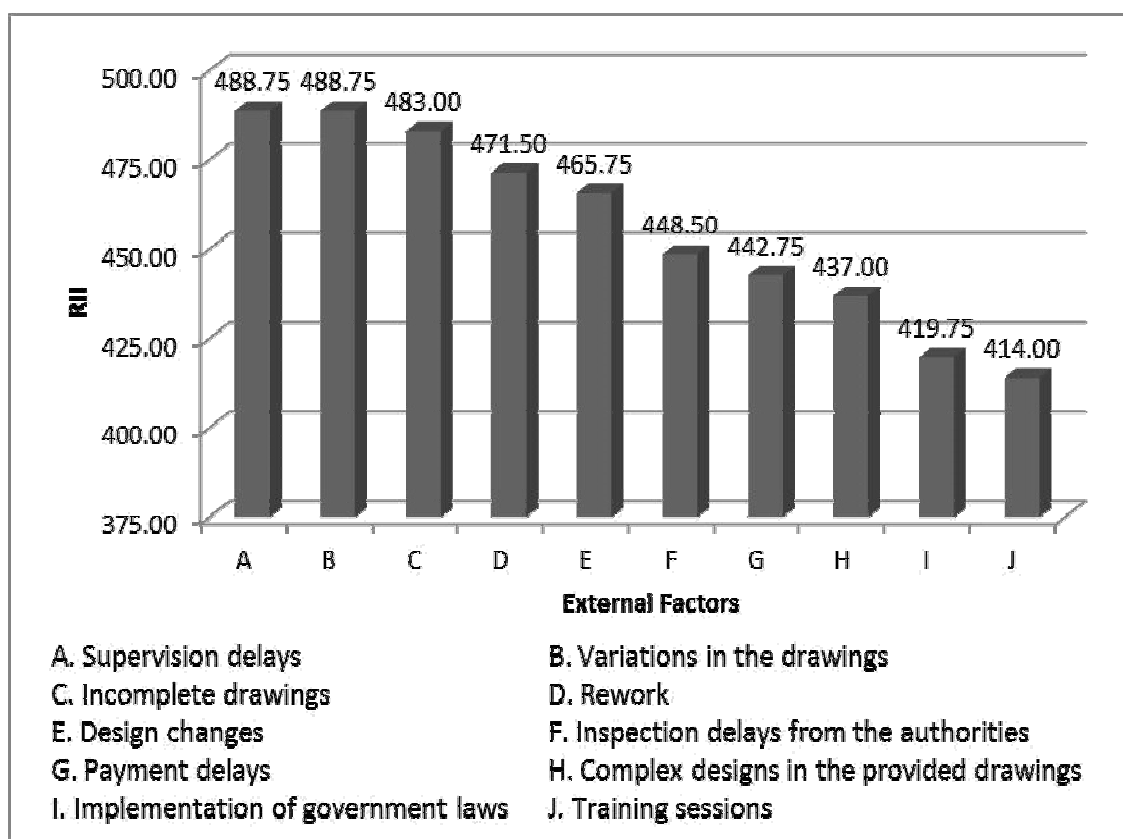| Factors	RII	Rank
Supervision delays	488.75	1
Variations in the drawings	488.75	2
Incomplete drawings	483.00	3
Rework	471.50	4
Design changes	465.75	5
Inspection delays from the authorities	448.50	6
Payment delays	442.75	7
Complex designs in the provided drawings	437.00	8
Implementation of government laws	419.75	9
Training sessions	414.00	10

Figure 4.2. External Factors.

Inspection delays from the authorities were ranked 6th in the external group, with an RII of 448.50, and 22nd among all 40 factors that affect labour productivity (Table 4.11). Past study (Guhathakurta and Yates., 1993; Olomolaiye et al., 1996) proves that inspection delays are an important process; for example, because contractors cannot cast concrete before inspection of formwork and steel work, the inspection delay contributes to delays in work activities. It completely stops the task that requires the presence of supervisors, such as casting concrete and backfilling. Additionally, it delays the inspection of completed work which, in turn, leads to a delay in the commencement of new work.

Variations in the drawings were ranked 2nd in the external group, with an RII of 488.75, and 14th among all 40 factors that affect labour productivity (Table 4.11). Incomplete drawings were ranked 3rd in the external group, with an RII of 483.00, and 16th among all 40 factors that affect labour productivity (Table 4.11). Design changes were ranked 5th in the external group, with an RII of 465, and 21st among all 40 factors that affect labour productivity (Table 4.11). A complex design in drawings ranked 8th in the external group, with an RII of 437.00, and 27th among all 40 factors that affect labour productivity (Table 4.11). (Thomas et al. 1999) stated that "there is a 30% loss of efficiency when work changes are being performed. This result can be interpreted as changes to specifications and drawings that require additional time for adjustments of resources and manpower so that the change can be met. Also known as designer errors and omissions, these changes relate to plans that are incomplete or contain errors that are difficult to find until the construction contractor finds them well after the construction phase of the project has started. With most construction contracts, where the contractor bids on designs that are completed prior to contract award, the owner is liable for the designer's errors and omissions".

Payment delays were ranked 7th in the external group, with an RII of 442.75, and 24th among all 40 factors that affect labour productivity (Table 4.11). Payment delays in the construction industry are adversarial and disastrous. Late payment affects a company's cash flow and may ultimately lead to a business's failure. Timeliness of payment is important to avoid the risk of the late-payment problem. A study by Zou et al. 2007 pointed out that project-funding problems have been identified as cost-related risks, time-related risks, and quality-related risks which can significantly influence the delivery of a construction project. The risk of delayed payment from the owner impacts the duration and cost of the project. These risks causes the project's cost to increase abnormally and, subsequently, delay the project's progress.

Rework ranked 4th in the external group, with an RII of 471.50, and 19th among all 40 factors that affect labour productivity (Table 4.11). Past study from confirmed that rework is one of the major factors in the construction industry to affect labour productivity in building construction. The study also listed rework as one of the critical factors effecting productivity and stated that rework is due to incompetent craftsmen and supervisors.

Implementing government laws was ranked 9th in the external group, with an RII of 419.79, and 31st among all 40 factors that affect labour productivity (Table 4.11). For most projects, government authorities refer to specific versions and construction standards of their design. Sometimes, government authorities, who have documented standards for design and construction, may decide to revise those standards after the job has been awarded, based on a previous version, thus affecting the overall labour productivity of the building construction.

Training sessions were ranked 10th in the external group, with an RII of 414.00, and 33th among all 40 factors that affect labour productivity (Table 4.11). Past studies from (Lema and Samson 2002), (Cheung et al. 2004), and (Iyer and Jha 2005) stated that persons entering the construction industry directly from high school usually start as inexperienced in construction industry or as labour ers. They can learn from their job quickly by working closely with experienced people. Whereas, skilled labour ers, such as carpenters, bricklayers, plumbers, and other construction trade specialists, most often get their formal instruction by attending a local technical school or through an employer-provided training program.

V. CONCLUSION

In today's world, the construction industry is rated as one of the key industry. It helps in developing and achieving the goal of society. Study and knowledge of construction productivity are very important because they cause losses to the governing agencies and also influence the economics of the construction industry. Prior knowledge of labour productivity during construction can save money and time. Investments for these projects are very high and because of the complexity in construction, various factors can highly affect overall productivity, thus the project can end up adding even more time and money in order to be completed. This research is intended to identify the causes of probable factors affecting labour productivity in building construction. The survey results are subjected to analysis, and the ranking of factors is calculated using the Relative Important Index. The basic ideas of the research is to study various factors affecting labour productivity on construction.

Forty factors considered for the study were categorized in five different groups' manpower, external, communication, resources, and miscellaneous groups. The target groups in this study were construction professionals. Total of 255 questionnaires were distributed, and 28 questionnaires (11.00% response rate) were returned. Because project engineers, project managers have vast experience in construction, their adequate experiences were a proper suggestion to study about the various construction factors affecting labour productivity.

A. Recommendations

Construction tasks are expensive and frequently cause in arguments and claims, which generally affects progress of construction projects. The environment of construction organizations should be suitable to implement projects with successful completion. In the construction industry, it is necessary to find the weaknesses of particular task in order to solve and overcome them. Mentioned below are the recommendations which were found to be important factors for improving labour productivity in the construction industry.

1) A detail schedule of material supply schedule for each project should be provided by the contractors. It should contain the time required to supply materials and the availability of the local market to furnish the required materials in time. Extra attention is required on quality of construction materials and tools used in their projects because using suitable materials and tools reduces both the time taken to finish the work and wastage of materials. Using suitable materials and tools also has a positive effect on the task and thus, better labour productivity can be achieved.

2) Organizations should make sure there is enough lighting present at the construction sites which can indirectly reduce the number of accidents. Continuous safety training and meetings should be arranged to achieve better performance in labour productivity.

3) Purchased material should be stored at appropriate location and should be easily accessible and close to constructed buildings to avoid wasting labour time for multiple-handling materials.

4) Recruiting manager and project managers should recruit appropriate candidate to particular task. Friendly relations should be maintained with labour s and made aware of their importance to the organization

5) To achieve desired results, time required implementing change orders and to make corrections in drawings and specifications should be estimated and scheduled without affecting the project-time completion. Regular meetings should be arranged with the project authorities.

6) Various external and natural factor risks should be considered in the budget estimation to minimize delays due to closures and material shortages. There should be suitable emergency budget to cover cost of increased material.

7) A financial incentive in the form of best employee of the year should be implemented to create competition among the employees, thus achieving better productivity.

8) Strict drug and alcohol tests should be implemented on a surprise basis and strict action should be taken with the employees who test positive.

9) Complex design and incomplete drawings should be avoided and care should be taken to avoid confusion among the various construction agencies.

10) If the construction sites are present in remote geographical locations where public or employees' own transportation facilities cannot be made available, appropriate organized transportation should be given to the employees.

11) Change orders and design error should be avoided as much as possible. These factors can be costly and time consuming if the work has been done. Work sequences can also be affected due to rework.

12) Absenteeism at work site can be reduced with inclusion of appropriate paid time off and vacations to all employees.

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