Technology Assessment in Context to Productivity Analysis for Tower Cranes

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Abstract

Construction industry as a growth engine of development for the India economy contributes a large Investment in plant, Equipment and Facilities to generate a best service or product. This industry has frequently constituted a large part of the Gross Domestic Product, with the figure likely to be higher in developing than developed countries, thus it becomes necessary to study technology assessment involved. Technology Assessment is a systematic identification, analysis, and evaluation of the full range of impacts, both beneficial and detrimental, which may result from the introduction of a new technology or changes in the application and utilization of existing technology. Study area, Ahmedabad being an important city of Gujarat has a noticeable amount of use of tower cranes in recent days, so study of factor affecting a productivity of tower crane can help in decision making of its Study contains a questioner survey of relative importance of various factors which affects in operating tower cranes at various sites of Ahmedabad city. Data analysis is performed using RII method based on scale of 1 to 5.

1. Introduction

With the use of advanced technology, it becomes necessary to determine its impact in any form for a construction industry at regular intervals. Productivity is the main parameter to determine the technology assessment. It illustrates, that which equipment or machine is more capable of generating maximum output with a minimum input. Tower crane modern form of balance crane that consist of the same basic parts but with some technical enhancements, it is either fixed to the ground on a concrete slab or sometimes attached to the sides of structures often give the best combination of reach of height and lifting capacity which is suitable to use in construction of tall buildings.In simple terms, productivity can be expressed as the relationship between the output generated from a system and the input used to create output.

Productivity=Input/Output (1)

2. Components of Tower Crane

- Base: This forms the base of the tower crane and it is very important component as it forms the interface between the tall steel structure and the concrete building top. It can be compared to the spine supporting a human body. The steel structure of the tower crane is bolted to the concrete pad.
- The Mast or the Tower: The base is connected to the mast or the tower, which gives the height to the crane. This mast or the tower has guard rails and guide rails which guides the elevator. This elevator facilitates the operator and the maintenance technician to reach the operator's cab and the machinery arm from the base.
- The Slewing Unit: This is the mobile unit of the tower crane, which is capable of rotating almost 360 degrees. The rotation of the crane around its own axis is called slewing. It is a set of combination of

huge gears and motors which enables the crane to slew. On top of the slewing unit, the tower crane has three more parts long horizontal jib, the machine house and operator's cabin.

3. Study Area Profile

Ahmedabad being the largest city in Gujarat, and also administrative capital of Ahmedabad district, have several well known landmarks such as Civil Hospital (biggest hospital in Asia), BRTS system, Sabarmati Riverfront, Kankariya Lake etc., and it should be noticed that most of them are developed in last decade which shows remarkable use of technology and equipments in construction. There are about 815 developers and contractors in the City according to AUDA, and about 250 ongoing large projects. The tallest residential building "Takshashila Air" is under construction near Sabarmati River. Some major projects like metro rail from Ahmedabad to Gandhinagar, GIFT City, Bullet train from Ahmedabad to Mumbai, which could be more advantageous towards regional development.

4. Methodology

To carry out research, questionnaire has formed based on factor which effects on productivity of tower cranes used at different construction sites having variable heights. Data collected through survey helps to determine the major and minor factors which affects on tower crane's productivity using RII method. Scope of the study is limited to the construction sites where tower cranes are under operating conditions, due to which research has produced a small quantum of survey numbers.

The ranking (or scale) given by respondents for factors in questionnaire represents the degree of importance (from a scale of one to five) given to each of these factors. Respondents were asked to rank the degree of importance to a variety of factors in relevance to the operation of cranes under any conditions.

Then "RII Index" is calculated for each factor by using the formula:

$$RII = \Sigma W/(A * N) \quad (2)$$

Where, RII = Relative Importance Index

W = Weight given to each factor by the respondents (from 1-5)

A = highest weight (5).

N = total number of respondents.

Table 1: RII Index Scale

Item	Very High Important	High Important	Medium Important	Low Important	Very Low Important
Scale	5	4	3	2	1

- Wind Velocity: It increases as increase in height of operation, and thus affecting overall balance of material carrying bucket and boom.
- Weather: It plays a vital role in operation since rainy and too dark atmospheric conditions are unfavourable to work. Monitoring such parameters can be helpful to operator.
- Visibility: As a distance to be observed by operator during use of crane from its cabin is large, and also ground level visibility is also on priority with respect to end of the jib proper visibility conditions are preferred.
- Operator's skill: This is one of the most important factor for tower crane productivity, experienced operatorsshould be appointed for task.
- Use of multiple languages: availability of local cranes operators are sometimes a constraints for developers. So during operation of cranes many new words or terms are to be understood from both the sides, hence it also becomes an important factor.

- Presence of overlapping cranes: This factors comes into the consideration while there are more than one cranes installed and under operation, though swing time for both of them varies but still it needs to be noticed.
- Presence of obstacles on site: Presence of obstacles like high-tension electric line, neighbourhood building during swinging time effect on the tower crane productivity.
- Length of work shift: efficiency of operator directly depends on this factor, as rest is needed for batter concentration towards operation of crane.
- Proficiency of the lifting supervisor: Lifting supervisor must be efficient to lift out maximum material. So that number of cycle may be increase which increase productivity of tower crane.
- Crane operator's experience and proficiency: Productivity will be high if operator is experienced. Operator can overcome to the problem that arises during operation.
- Crane operator's mental capacity: Crane operator must be able to work at heights without any psychological problems under any circumstances.
- Inspection of crane: It directly increases the efficiency as parts and other related mechanism plays a vital role in cranes operation. It also enhances the life span of crane thus resulting in low maintenance cost.
- Regular inspection of lifting devices: Lifting device must be checked at regular interval for its weight carrying capacity.

5. Data Analysis

From the data collection through questionnaire shown in table 2, Out of the entire 24 respondents, 10 respondents have ranked the wind velocity as very high important factor (5 rating),10 respondents have ranked it is as high importance (4 rating), 1 respondent have ranked it is as medium importance (3 rating), 2 respondents have ranked it as a low importance (2 rating) and 1 respondent have ranked it as a very low importance (1 rating).

Weightage of wind velocity $\Sigma W = (1*1)+(2*2)+(3*1)+(4*10)+(5*10)= 98$

Now, Highest Weigh (A) = 5

Number of respondent (N) = 24

So, RII Index as per equation (2)

= 98/ (5*24)

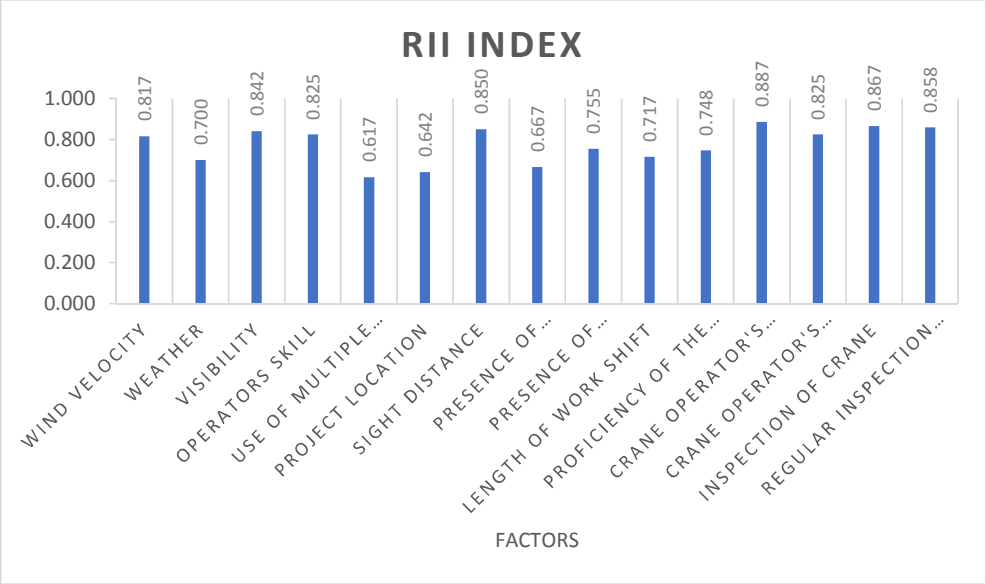
= 0.817

Table 2. Calculation of Factor Affecting on Tower Crane Productivity

RII Index – Factor Affecting On Tower Crane Productivity						
No.	**Factor Affecting On Productivity**	**1**	**2**	**3**	**4**	**5**
1	Wind Velocity	1	2	1	10	10
2	Weather	1	3	9	5	6
3	Visibility	0	2	3	7	12
4	Operators skill	0	2	4	7	11
5	Use of multiple language	1	5	12	3	3
6	Project location	4	2	8	5	5
7	Sight distance	0	0	5	8	11
8	Presence of overlapping cranes	2	6	4	1	8
9	presence of obstacles on site	0	2	6	9	5
10	Length of work shift	0	4	8	6	6
11	Proficiency of the lifting supervisor	1	1	6	10	5
12	Crane operator's experience and proficiency	0	0	3	7	13

13	Crane operator's mental capacity	0	2	5	5	12
14	Inspection of crane	0	2	4	2	16
15	Regular inspection of lifting devices	0	2	3	5	14

Figure 1
RII Index Calculation of Factor Affecting On Tower Crane Productivity



6. Conclusion:

Though data collected from survey could not be a judgment making tool, since it could be subjective from different perspective of every person. A data analysis using RII method has proved that crane operator's experience and proficiency is the major factor affecting on the tower crane's productivity succeeded by inspection of crane, regular inspection of lifting device and sight distance and angles respectively and least most important factor is use of multiple language.

So, conclusion can made that proper maintenance of crane and operator's proficiency of use under any conditions, are two main factors to be focused on for more productivity.

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