

The economic model of productivity construction essay

[Business](#), [Industries](#)



**ASSIGN
BUSTER**

In the yesteryear, several surveies about labour productiveness in the building were done.

Some of them are related to quantifying the impact of productiveness factors. Quantitative ratings about the effects of those factors are required for many intents, including building estimating, planning, programming, and cogent evidence of amendss for the building claims. However, an extended reappraisal of relevant literature reveals that it is hard to quantify such an impact, and there are presently no universally accepted criteria for quantifying factors impacting productiveness loss in the building industry.

This deficiency of a agency for quantifying impact high spots the demand to heighten quantitative ratings for the factors impacting productiveness in edifice building, which is the topic of this survey. Achieving better labour productiveness requires elaborate surveies of the existent cost of labour. Assorted labours have different variables impacting their degrees of productiveness. For every undertaking, productiveness, cost, quality, and clip have been the chief concern. Better productiveness can be achieved if project direction includes the accomplishments of instruction and preparation, method of work, personal wellness, motivational factors, type of tools, machines, equipment and stuffs required, personal accomplishments, work load to be executed, expected quality of work, location of work, type of work to be done, and supervisory forces (Rowlinson and Proctor, 1999) .

Bettering productiveness is a important concern for any profit-oriented organisation, stand foring the effectual and efficient transition of resources into marketable merchandises and finding concern profitableness (Wilcox et

al. , 2000) . Consequently, considerable attempt has been directed to understand the productiveness construct with the different attacks taken by research workers, ensuing in a broad assortment of productiveness definitions (Lema, Samson, 1995 ; Oglesby et Al, 2002 ; Pilcher, 1997) . A study conducted by (Bernstein and Lemer 1996) states that 10 million people are employed in the U. S. building industry. Therefore, sing drawings, designs, new building, redevelopments, equipment, and material fabrication, it can be said that the building industry is one of the largest fabrication industries in the USA. 1.

2. Background About ProductivityProductiveness is by and large defined as the mean direct labour hours required to put in a unit of stuff. It is said that perfect productiveness (1. 0) can be achieved with a 40-hour work hebdomad, with people taking all the vacations and holiday yearss as planned, all of the technology drawings would be 100 % complete there would be no holds of any sort ; everyone would work safely ; everything would suit hone first clip ; the conditions would be 70 oF ; and there would be no judicial proceeding at the terminal of the undertaking (Rowlinson and Proctor, 1999) . Productivity, in general, represents the witting growing of a society or an organisation in its ability to better the value or the quality of its merchandises or services. The success of an organisation can be more clearly measured by its productiveness growing than by its growing in net incomes. However, productiveness is theoretically defined as a ratio between end product and input.

In the context of the building industry, the end product is the construction, or installation, that is built or some constituent. The major inputs for the building procedure include manpower, stuffs, equipment, direction, energy, and capital (Bodek, 1985) . 1.

3. Definition of Productivity in the Construction IndustryThe term “productiveness ” expresses the relationship between end products and inputs (Borcharding and Liou, 1986) . Output and input differs from one industry to another. Besides, the productiveness definition varies with the application to different countries of the same industry.

In the building industry, there is a demand for utilizing different theoretical accounts, such as the economic theoretical account, the project-specific theoretical account, and the activity-oriented theoretical account (Davies, Thomas, 1990) . Productivity = $\frac{\text{Outputs}}{\text{Input}}$ signalEquation 1. 1The Project-Specific Model Productivity = $\frac{\text{Square Feet Output}}{\text{Dollars of Input}}$ signalEquation 1. 2The Activity-Oriented Model Productivity = $\frac{\text{Output}}{\text{Labor cost}}$ Equation 1.

3The Economic Model of Productivity = $\frac{\text{Dollars of Output}}{\text{Dollars of Input}}$ signalEquation 1. 4Labor is one of the basic demands in the building industry. Labor productiveness normally relates manpower in footings of non-hour or labour cost to the unit of end products produced (Borcharding and Liou, 1986. In other words, the definition of labour productiveness is the sum of goods and services produced by a productive factor (work force) in the unit of clip (Drewin, 1982) . Ouesnat (Vaggi, 1987) says the beginning

of the word “ productiveness ” can be traced back to 1766. In 1883, LITTLE defined productiveness as the “ module to bring forth, ” that is, the desire to bring forth (Jarkas, 2005) . In 1950, the Organization for European Economic Cooperation (OEEC) introduced the definition of productiveness as a quotient obtained by splitting the end product by one of the production factors (Sumanth, 1984) . Depending on measuring aims and the handiness of informations, several productiveness definitions are encountered.

The U. S. Department of Commerce defines productiveness as “ dollars of end product per person-hour of labour input ” (Adrian, 1987) . 1. 4.

Importance of ProductivityProductivity has a great significance in building. Labor productiveness constitutes a considerable portion of production input for building.

In the building industry, there are many external and internal factors that are ne’er changeless and are hard to expect. This factor leads to a uninterrupted fluctuation in labour productiveness. It is necessary to do certain that a decrease in productiveness does non impact the program and agenda of the work and does non do holds. The effects of these holds could ensue in serious money losingss. Further, considerable cost can be saved if productiveness is improved because the same work can be produced with less work force, therefore cut downing overall labour cost (Thomas, 1991) .

1.

5. Measurement of ProductivityIt is hard to mensurate productiveness with building work due to the singularity and assorted operations of building

undertakings (Sweis, 2000) . Construction labour productiveness is typically measured as labour hours per measure of stuff installed. When a contractor, or an assigned crew, does not carry through the awaited or planned production rate, labour productiveness loss is experienced. In other words, a loss of productiveness is when it takes excess labour and equipment to make the same sum of work, thereby increasing undertaking costs.

There are many causes for labour productiveness impacts on a building undertaking, stemming from proprietors, contractors, and building directors. Common causes include, but are not limited to, misdirection, maladministration, site-access limitations, differing site conditions, faulty programs and/or specifications, alterations in the work, labour handiness, turnover, rework, testing/inspections, overtime and/or displacement work, interventions, alterations in building agencies and methods, out-of-sequence work, and differing conditions (Sweis, 2000) . 1.

6. Problem Statement Loss of productiveness is one of the most serious jobs in the building industry. Research surveys confirm that productiveness loss consequences from several causes, including inordinate alteration orders, long periods of overtime, hapless field direction, and utmost conditions (Alarcon and Borcharding, 1991 ; Leonard, 1987 ; Sanders and Thomas, 1991 ; Thomas and Oloufa, 1995) .

Construction labour cost is estimated to be 33-50 % of the entire undertaking cost (Hanna, et al 2005) . In labour-intensive building, the net income borders are typically 2-3 % of the entire undertaking cost. As labour

is more variable and unpredictable than other project-cost constituents, it becomes necessary to understand the effects of different factors on labour productiveness.

Compared to other project-cost constituents, such as stuff and equipment, labour cost has more chance to better by proper direction. An addition in productiveness reduces the labour cost in direct proportion. It can either profit or cut down a undertaking ' s net income, doing it of critical involvement to the building industry (Hanna, et al 2005) . Of the typical project-cost constituents (stuffs, equipment, and labour) , labour is considered the component incorporating the most hazard. The other cost constituents (stuffs and equipment) are predominately determined by the market monetary value and are, accordingly, beyond the influence of undertaking direction. As a consequence, the direction of labour and its productiveness becomes paramount in finding the success of a undertaking.

1. 7.

Misconceptions About Construction ProductivityA survey from Adrian (1990) states the undermentioned general misconceptions about labour productiveness: In the building industry, labour is the cardinal factor for low productiveness. Because the building industry is controlled by the conditions, productiveness can non be improved. The building industry will ever be an unfavourable relationship procedure.

1. 8. Facts About Construction ProductivityFollowing are a few facts about the building productiveness studied by Adrian (1990) : Compared to any

other twenty-four hours of the hebdomad, labour is most productive on Tuesday.

The most productive clip of the twenty-four hours for labour is around 10 a. m. The least productive clip frame for labour is right before the finishing clip. Laborer is capable of raising about 94 lbs on his ain. If the labourer is engaged in executing the same undertaking repeatedly, there will be a opportunity of low productiveness after 60-70 proceedings of executing the same work. Friday has been proven to be the least productive twenty-four hours of the hebdomad. 1.

9. Aim and Objective Poor productiveness of craftsmen is one of the causes for cost and clip overproductions on edifice undertakings. Productivity of labour is of great importance, particularly in developing states where most of the edifice work is still done manually (Alinaitwe, 2005) . The aim of this survey focuses on positions from the building industry about assorted factors impacting labour productiveness, analyzes factors impacting labour productiveness impact, and suggests appropriate steps that can be taken to better labour productiveness. The purpose is supported by the undermentioned aims. To analyze and discourse assorted factors impacting labour productiveness in the building industry.

To analyse and cipher the Relative Important Index (RII) of those factors impacting labour productiveness. To do recommendations to better labour productiveness in building. Background of Productivity Conclusion/Recommendation Datas Analysis Data Preparation Data

CollectionPilot SurveyQuestionnaire DesignLiterature Review/Issue
IdentificationFigure 1.

1. Flow Chart Showing Research Structure. Chapter 2. LITERATURE REVIEW2.

1. Review of Previous StudyPrior to the mid-1960s, the building industry reflected a rise in productiveness (Stall, 1983) . Since so, poorer productiveness has been one of the most normally discussed subjects in the building industry.

In 1968, the Construction Roundtable was established due to concern about the increased cost of building ensuing from an addition in the rising prices rate and a important diminution in building productiveness (Thomas and Kramer, 1988) . Besides in 1965, the United Nations Committee on Housing, Building, and Planning (UNC) published a important manual referring the consequence of repeat on edifice operations and procedures (UNC, 1965) . The survey revealed that the demand for an addition in productiveness was likely more intense in the building industry than in many other industries.

It was necessary to follow, every bit far as possible, industry-wide rules of production throughout the edifice procedure. However, it was recognized that careful version would be required to implement the cognition and experience gained in the fabrication industry to the edifice building industry (Borcharding and Alarcon, 1991) . Many research workers around the universe have done different studied on assorted factors that affect productiveness ; in malice of these surveies, there are many productiveness jobs that remain unknown and need to be farther investigated, even in

developed states (Makulsawatudom and Emsley, 2002) . A survey by (Polat and Arditi, 2005) stated that policies for increasing productiveness are non needfully the same in every state. Their survey identified factors impacting labour productiveness and grouped the factors harmonizing to their features: design, executing program, stuff, equipment, labour, wellness and safety, supervising, working clip, undertaking factor, quality, fiscal, leading and coordination, organisation, owner/consultant, and external factors.

(Adrian, 1987) classified the factors doing low productiveness as industry-related factors, labor-related factors, and management-related factors.

Industry-related factors, basically, are the features of the building industry, such as the singularity of building undertakings, varied locations,

inauspicious and variable conditions, and seasonality. Labor-related factors include the brotherhood ' s influence, small potency for acquisition, and deficiency of motive. Management-related factors normally refer to a

deficiency of direction for tools or techniques.(Olomolaiye et al, 1998)

divided the productiveness factors into two classs, external factors stand foring those outside the control of the house ' s direction and internal factors on behalf of productiveness factors arising within the house. From his point of view, the nature of the industry, normally the separation of design and building maps, has affected building productiveness through waiting for drawings, design alterations, and subsequent rework.

The building clients have sometimes been hindrances to building productiveness because of their deficiency of equal cognition about building processs. Furthermore, being an outdoor industry, building public

presentation is highly affected by the conditions conditions. The degree of economic development besides affects productiveness. In add-on to the factors described above, wellness and safety statute law, procurance policies, and codifications of patterns are other external factors act uponing site pattern and productiveness. In the internal class, direction insufficiencies could ensue in a waste of resources with attendant losings in productiveness ; acceptance of advanced engineering and preparation for the labourer would better productiveness.(Thomas and Sakarcan, 1994) built a theoretical account to depict the factors impacting labour productiveness. In the theoretical account, two groups of factors determine the productiveness public presentation, work environment and work to be done.

Work-environment factors refer to how good a occupation is organized and managed. Work to be done, or work content, relates to work that needs to be done and encompasses physical constituents of work, specification demands, and design inside informations. Past survey show the work to be done could impact the entire cumulative labour resources by every bit much as 15 % , whereas work environment can impact labour demands by an extra 25 % . Based on this factor theoretical account, research was done in more item. One survey suggested that scheduled overtime ever leads to losings of efficiency because of the inability to supply stuffs, tools, equipment, and information at an accelerated rate (Ginther, 993) Surveies and interviews are standard methods that have already been adopted in many productiveness surveies. (Lim and Alum, 1995) conducted a study of top

civil technology and edifice contractors to place the factors impacting productiveness in Singapore.

The three points of greatest concern were identified as trouble in the enlisting of supervisors, trouble in the enlisting of labours, and a high rate of labour turnover. (Portas and AbouRizk, 1997) undertook a questionnaire of overseers and undertaking directors to find all possible factors impacting productiveness. An interview conducted with contractors showed that conditions and material bringing were the chief inauspicious factors for site productiveness (Hassanein and Melin, 1997) . A questionnaire identified rework, stuff jobs, tools, heavy equipment handiness, crew intervention, overcrowded work countries, direction, quality-control review, and direction intercessions as the chief factors impacting craftsman productiveness and motive (Chang and Borcharding, 1985) . Another study on building forces (Hanna and Heale, 1994) was conducted to estimate the sentiment of forces in the field of building, specifically their cognition about the factors that most affect building productiveness.

As a consequence, a set of comprehensive factors was identified and classified into six groups: contract environment, planning, site direction, working conditions, working hours, and motive.(Ng et al, 2004) found that the morale of workers at the civil technology sites visited was comparatively low, with demotivation happening due to extended rework, overcrowded work countries, jobs in crew interfacing, handiness of tools, holds in review, handiness of stuffs, and incompetency of site chiefs. The consequences

indicates that the entire clip lost in the 7 civil technology undertakings surveyed due to demotivation of workers ranged from 5.

1 to 13. 6 adult male hours/week, with the most important clip lost being caused by a deficiency of stuff handiness, overcrowded work countries, and rework resulting of hapless direction and hapless communicating at the site. Should direction hold been sensitive to these demotivators, it was possible that their impact could hold been reduced. The survey besides showed that undertaking value was found to hold a negative correlativity with the clip loss due to demotivation, bespeaking that, as undertaking size additions, clip loss lessenings. Directors besides needed to be cognizant that higher clip losingss can happen during the immediate phases of undertakings. As undertakings progress towards their extremum at the site activity, more activities from workers will be involved, and coordination and communicating jobs will be inevitable. By paying more attending to building employees at this phase, it may be possible for undertaking directors to turn to these jobs before they grow farther. 2.

2. Different Factors Affecting Labor Productivity from Previous

Surveys Productivity is the result of several interconnected factors.

Discussed below are assorted factors impacting labour productiveness in building reviewed from old survey. Time: During building undertakings, there are legion fortunes and events which may do a loss of productiveness.

It has been systematically documented over the old ages that productivity typically diminutions as overtime work continues. The most normally stated

grounds for this consequence include weariness ; increased absenteeism ; decreased morale ; reduced supervising effectivity ; hapless craft, ensuing in higher-than-average rework ; increased accidents ; and others On norm, no affair how many hours a hebdomad one plant, one will merely accomplish 50 hours of consequences. Overtime work will ab initio ensue in increased end product if it is continued for a drawn-out period ; the end product may really worsen for the grounds stated earlier.

Therefore, long-run overtime may take to increased costs and reduced productiveness (Hinze, 1999) . The consequence of continued overtime work on labour productiveness is, possibly, one of the most studied productiveness loss factors in the building industry. Time used by a building labourer on productive activities norms about 30 % of the entire clip available. An employee in the field merely works efficaciously for 3. 5 hours of his 8-hour displacement and spends 20 % of his clip on direct value-adding activities (Alinaitwe et al. , 2005) . Overtime is defined as the work performed over 8 hours/day or 40 hours/week.

Overtime can happen in a assortment of agendas, including 5 yearss with 10 hours worked per twenty-four hours [5 (10) s, 7 (8) s, 6 (10) s or 7 (10) s] (Hanna et al, 2005) . Short-run overtime is utilizing up to 50 or 60 hours per hebdomad for 1 or 2 hebdomads, and it is used to run into specific undertaking marks or to minimise downtime during a works closure. There are added costs for this short-run overtime, but productiveness and safety can be controlled by increased supervising and planning. When overtime is used for more than two hebdomads, the effects of drawn-out overtime start

to take consequence. Fatigue from longer hours of physical labour, overextended supervising, staff deficits, increased accidents, and other issues are all factors. Laborers start to take personal yearss and turnover additions.

Finally, the work completed each hebdomad approaches the degree that could hold been completed in 40 hours (Hanna, et al 2005) . Overtime achieves schedule acceleration by increasing the figure of hours worked by labourers beyond the typical 40 hours per hebdomad. Past research indicates that labour productiveness can be negatively impacted by overtime, doing jobs such as weariness, reduced safety, increased absenteeism, and low morale (Horner and Talhouni, 1995) . Willingness to Work: Motivation and morale of people are highly of import factors that determine productiveness. These factors are affected by wage-incentive strategies, labour engagement in direction, communicating systems, informal group dealingss, publicity policy, brotherhood direction dealingss, and quality of leading, working hours, sanitation, airing, subsidised canteen, and company conveyance (Kumar Cited in Desai 2004) . Schedule Compaction: Contractors are non lawfully bound to turn out that contract public presentation was extended to retrieve lost productiveness.

When there are holds early in a undertaking, compactions of the overall clip frame for a ulterior activity are frequently the manner to do up for holds and to complete the undertaking on clip. From a rigorous programming position, schedule compaction may be possible to make without speed uping single work activities by using float in the undertaking ' s overall agenda. However,

on many undertakings, agendas are non to the full resource laden. As a effect, a decently updated agenda reflecting the holds may demo the undertaking completing on clip without shortening single activities. Schedule compaction may ensue in over manning of the work by the contractor due to shortening the overall continuance, leting the contractor to finish the entire leftover work. Schedule compaction, when associated with over manning, frequently consequences in important productiveness losings due to dilution of supervising ; deficits of stuffs tools or equipment to back up the extra labour ; increased trouble in planning and organizing the work ; and deficits of skilled labour (National Electrical Contractors Association, 1983) . Type of Undertaking: To accomplish important productiveness, each member of a crew requires sufficient working infinite to execute work without being interfered with/by the other labourers. When more labourers are assigned to work in a fixed sum of infinite, it is likely that intervention may happen, therefore diminishing productiveness.

Additionally, when multiple trades are assigned to work in the same country, the chance of intervention rises and productiveness may be reduced.

Intervention among the assorted crews and labourers is caused by misdirection on building sites. For illustration, steel fixtures crew will hold to wait before repairing the support rods if the carpenter has non completed the formwork. Types of activities and building methods besides influence labour productiveness (Thomas and Sanders, 1991) . Safety: Accidents have high impacts on labour productiveness. Assorted types of accidents

occur on the site, such as an accident doing decrease and ensuing in a entire work arrest for a figure of yearss.

An accident that causes an injured to be hospitalized consequences in a lessening in work of the crew for which the injured worked. Small accidents ensuing from nails and steel wires can halt work and, therefore, lessening productiveness (Thomas and Sanders, 1991) . Even deficient lighting shows decreased productiveness because sufficient lighting is required to work efficaciously and because deficient lighting has negative effects.

Employment of a safety officer helps labourers to understand the needed safety ordinances and to follow them, which can forestall and cut down the figure of accidents, therefore increasing productiveness. Quality: Inefficiency of equipment and hapless quality of the natural stuff are the factors which cause low productiveness. Because the productiveness rate of inefficient equipment is low, old equipment is subjected to a big figure of dislocations, and it takes a long clip for the labourers to finish the work, therefore cut downing productiveness.

Poor-quality stuff used for work is the other factor because hapless stuffs lead to hapless work which can be rejected by the supervisors, therefore cut downing the productiveness. Managerial Factors: The competency and attitudes of directors have a important bearing on productiveness. In many organisations, productiveness is low despite the latest engineering and trained work force.

Low productiveness is due to inefficient and apathetic direction. Competent and dedicated directors can obtain extraordinary consequences from ordinary people. Employees ' occupation public presentation depends on their ability and willingness to work. Management is the accelerator to make both.

Advanced engineering requires knowing labourers who, in bend, work fruitfully under professionally qualified directors. It is merely through sound direction that optimal use of human and proficient resources can be secured. Manpower group: Literature shows that a deficiency of labour experience is the factor which negatively affects labour productiveness and proves that, to accomplish good productiveness, labour dramas a important function. Contractors should hold sufficiently skilled labourers employed to be productive. If skilled labour is unavailable and a contractor is required to build a undertaking with less-skilled labour, it is likely that productiveness will be impacted. The absence of any member of the crew may impact the crew ' s production rate because workers will, typically, be unable to carry through the same production rate with fewer resources or, possibly, a different mix of accomplishment and experience degrees. Misconstruing among labourers creates dissensions about duties and the work bounds of each labour, which leads to a batch of work errors and lessenings labour productiveness. Lack of compensation and increased laborer age negatively affect labour productiveness because labour velocity, legerity, and strength diminution over clip and cut down productiveness (Heizer and Render, 1990) .

Motivation: Motivation plays a portion in heightening building labour productiveness. Motivation can best be accomplished when labourers are able to unify their personal aspirations with those of the company. Therefore, motive can be defined as the willingness to exercise a high degree of attempt to make organisational ends, conditioned by the attempts ' ability to fulfill some single demand.

Factors such as payment holds, deficiency of a fiscal motive system, non-provision of proper transit, and a deficiency of preparation Sessions are grouped in this subject (Decenzo, Holoviak, 1990) . Supervisions: All undertakings encounter some alteration during building. When drawings or specifications are erroneous, equivocal, ill-defined, etc. , productiveness is likely to worsen because labourers in the field are unsure about what needs to be done. As a effect, they may decelerate down or gait their work, or have to halt all together while they wait for clear direction. There is a 30 % loss of efficiency when work alterations are being performed (Thomas, et al 1999) . Work review by the supervisor is an indispensable procedure to continue. For illustration, the contractor can non project concrete before an review of the formwork and steel work, therefore impacting labour productiveness (Zakeri, et al 1996) .

With non-completion of the needed work harmonizing to the specifications and drawings, supervisors may inquire for the rework of a specific undertaking. Supervisors ' absenteeism stops the work wholly for activities that require their attending, such as projecting concrete and backfilling, farther detaining review of the ready work which, in bend, leads to detain in

get downing new work. Material/Tools: Material direction is a cardinal component in undertaking planning and control.

If stuffs, tools, or building equipment are non available to a crew at the right location and clip, so the crew ' s productiveness will likely endure because workers may be unable to continue in an orderly, consistent mode. Choice of the appropriate type and size of building equipment frequently affects the needed sum of clip and attempt and, therefore, the job-site productiveness for a undertaking. It is, hence, indispensable for site directors and building contrivers to be familiar with the features of the major types of equipment most normally used in building. In order to increase job-site productiveness, it is good to choose equipment with the proper features and a size most suited for the work conditions at a building site. Laborers require a minimal figure of tools and equipment to work efficaciously. If the incorrect tools or improperly sized equipment is provided, productiveness may besides endure (Alum and Lim, 1995 ; Guhathakurta and Yates, 1993) . The size of the building site and the material storage location have a important impact on productiveness because labourers require excess clip to travel required stuffs from inappropriate storage locations, therefore ensuing in productiveness loss (Thomas and Sanders, 1991) .

Project direction factors: Work that is non decently scheduled, deficit of critical building equipment or labour, and the wrong mix of labour crews may ensue in reduced productiveness because crews may non be able to work every bit expeditiously as they would otherwise make. Improperly planned and implemented undertaking induction processs may besides take to lost

labour productiveness. Labor productiveness can be impacted by mobilising labour prior to holding entree to site electrical power or prior to holding equal site parking. Additionally, hapless site layout can lend to loss of productiveness. Labors have to walk a long manner to tiffin suites, tool cot, lay down countries, washrooms, entrywaies and issues impacting overall productiveness. (Cited in AACE IRP 2004 International Recommended Practice No. 25R-03 Estimating Lost Labor Productivity in Construction Claims)

Natural Factors: Natural factors, such as physical, geographical, and clime conditions, exert considerable influence on productiveness, peculiarly in utmost climes (excessively cold or excessively hot) . Natural resources, such as H₂O, fuel, and minerals, influence productiveness.

External Factor: Some terrible conditions is to be expected on about every undertaking. Pushing weather-sensitive work from good conditions periods to periods of extreme conditions, or meeting remarkably utmost conditions, may impact productiveness (e. g. , earth backfill and compression operations pushed into wet-weather periods) . Adverse winter conditions, such as air currents and rains, reduces productiveness, peculiarly for external work such as formwork, tee work, concrete casting, external daubing, external picture, and external tiling. Adverse conditions sometimes stops the work wholly (Thomas and Sanders, 1991) .

Sociological Factors: Social imposts, traditions, and establishments influence attitudes towards work and occupation. For case, prejudice on the footing of caste, faith, etc. inhibited the growing of modern industry in some states. The joint household system affected the inducement to work hard in India.

Close ties with the land and native topographic points hampered stableness and subject among industrial labourers (A. Kumar Cited in Desai 2004)Political Factor: Law and order, stableness of authorities, harmoniousness between provinces, etc. are indispensable for high productiveness in industries.

The authorities ' s revenue enhancement policies influence willingness to work, capital formation, modernisation and enlargement of workss, etc. Industrial policy affects the size and capacity of workss. Duty policies influence competition. Elimination of inefficient units helps to better productiveness (Kumar Cited in Desai 2004)Economic Factors: The size of the market, banking and recognition installations, conveyance and communicating systems, and other are of import factors act uponing productiveness. 2. 3. Designation of Possible Factors Affecting Productivity in Building ConstructionBased upon the Literature Review, this survey extracts assorted factors impacting labour productiveness in building from all old research surveys.

Some similar factors were merged together, and some new factors were added. Table 2. 1 below shows assorted factors impacting labour productiveness in building extracted from old survey. Table 2. 1.

Factors Affecting Labor Productivity in Construction (from Previous Study) .

Factors Affecting Labor Productivity in Construction

A

Bacillus

C

Calciferol

Tocopherol

F

Gram

Hydrogen

I

Joule

A

Management Characteristic

the degree of direction control

a? s

a? s

Professionalism of design squad

a? s

a? s

a? s

a? s

Troubles in using site supervisor

a? s

a? s

a? s

Work planning and programming

a? s

a? s

a? s

a? s

a? s

a? s

Incompetence of site supervisor

a? s

a? s

a? s

a? s

a? s

a? s

a? s

a? s

Late review of completed work

a? s

Bacillus

SITE AND RESOURCE-MANAGEMENT CHARACTERISTICS

Coordination of subcontractor

a? s

a? s

a? s

Quality control

a? s

Unsecured building site

a? s

a? s

a? s

a? s

Communication dislocation

a? s

a? s

a? s

a? s

Information

a? s

a? s

Rework (incorrect information given by supervisor)

a? s

a? s

a? s

a? s

a? s

a? s

Congestion

a? s

a? s

a? s

a? s

a? s

a? s

a? s

a? s

Sequence of work

a? s

a? s

a? s

a? s

a? s

a? s

a? s

Trouble in enlisting or handiness of work force

a? s

a? s

a? s

a? s

a? s

Fiscal jobs (late payment by client)

a? s

Fiscal jobs (payment to providers)

a? s

a? s

Handiness of stuffs

a? s

a? s

a? s

a? s

a? s

a? s

a? s

a? s

a? s

Handiness of tools and machinery

a? s

a? s

a? s

a? s

a? s

a? s

a? s

Method and machinery (including damage)

a? s

a? s

a? s

a? s

a? s

a? s

C

Undertaking CHARACTERISTICS

LocationInclement conditions (temperature and humidness)

a? s

a? s

a? s

a? s

a? s

a? s

a? s

Undertaking features

a? s

a? s

a? s

Specification

a? s

Structure size

a? s

Design demandUndertaking size

a? s

Site entree

a? s

Site features (including wellness)

a? s

a? s

Table 2. 1 (continued) a^|a^|

Factors Affecting Labor Productivity in Construction

A

Bacillus

C

Calciferol

Tocopherol

F

Gram

Hydrogen

I

Joule

Calciferol

WORKFORCE CHARACTERISTICS

Quality: Experience, preparation, and instruction degree

a? s

a? s

Perturbation

a? s

a? s

a? s

a? s

a? s

Morality (e.

g. , intoxicant influence or societal jobs)

a? s

Frequent alterations in labours

a? s

Communication jobs between labourers

a? s

a? s

Employee turnover

a? s

a? s

a? s

a? s

Absenteeism

a? s

a? s

Tocopherol

EXTERNAL CHARACTERISTIC

Acceleration: Overtime agenda

a? s

a? s

a? s

a? s

Variation order

a? s

a? s

a? s

a? s

Current economic status

a? s

a? s

Research and development

a? s

Mentions: A. Abdul Kadir et Al. (2005) B. Rojas and Aramvareekul (2003)C.

Park (2002) D. Ovararin and Popescu, C. M. (2001)E. Kaming et Al.

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(1998) F. Kaming et Al. (1997) G. Zakeri et Al. (1996) H. Lim and Alum
(1995) I. Thomas and Sakarcan (1994) J.

Halligan et Al. (1994) . Table 2.

2. Possible Factors Affecting Labor Productivity (in Alphabetical Order)

Sr. No.

Factors impacting labour productiveness in edifice building

1Accidents2Bad airing3Construction method4Drawings and specifications
alternated during executing5Government ordinance6High quality of needed
work7Increasing figure of labours8Inefficiency of equipment9Inspection
hold10Insufficient transit mean11Insufficient illuming12Intervention13Labor
absenteeism14Labor disloyalty15Labor dissatisfaction16Lack of
competition17Lack of fiscal motive system18Lack of labour
experience19Lack of labour acknowledgment plans20Lack of labour
surveillance21Lack of periodic meeting with labour22Labor personal
jobs23Lack of topographic point for feeding and relaxation24Lack of the
preparation session25Low quality of natural stuffs26Material
deficit27Misconstruing among labourers28Misconstruing between labourers
and overseers29Misuse of clip agenda30Noise31Payment
holds32Rework33Supervisors ' absenteeism34Tool and equipment
deficits35Type of activities in the undertaking36Unsuitability of stuffs
storage location37Misdemeanor of safety safeguards38Weather
alteration39Working at high topographic points40Working
overtime41Working within a confined infinite

Chapter 3. RESEARCH

METHODOLOGY Survey research is defined as a method of observation that involves the aggregation of informations through inquiring people inquiries (Fowler, 1993). For this research survey, the informations aggregation had the option from two basic methods: the questionnaires and personal interviews. A questionnaire was chosen as the most efficient and appropriate data-collection technique for the survey.

The questionnaire was described as a self-administered instrument with web-design inquiries, an appropriate respondent. It was seen that a questionnaire in a web-survey format is cost and clip efficient for the research worker while allowing the respondent to reply the questionnaire at personal convenience. However, the method is inflexible, and the response rate is by and large lower than for other methods such as interviews. Data ' s were collected from literature reappraisals on books, diaries, articles, seminar conferences, and web sites which emphasize the edifice building ' s labour productiveness.

A study was given to the employees from different trades involved with the building undertaking. 3. 1. Survey Planing For this survey, the questionnaire was distributed by electronic mail. The intent of the study was to garner information about the factors impacting labour productiveness in the edifice building industry. The intent and attack used in the study was to the full explained to the respondents.

Guidelines were provided to the respondents to guarantee that the process was followed decently to cut down mistakes. During the study period, some

periodical inadvertences were provided to assist guarantee the procedure was traveling swimmingly and systematically. The informations were stored in order to keep confidentiality, and the end product was received from the Group Discussion Center GDC in the signifier of electronic mail, which included natural informations sheets, drumhead sheets, and computing machine databases. Consequences included the overall statistics every bit good as single statistics³. 2. Considerations for the SurveyThe chief consideration for a study was that it should be easy for respondents.

If inquiries are excessively complicated, it would take to a high “ drop-out ” rate. Care was taken so that theA inquiries did non negatively act upon the consequences of subsequent inquiries. Sometimes, by supplying excessively much information or by unwrapping the intent of the survey, consequences may go colored. Preliminary text was introduced for explicating the study undertaking to the respondents. Page breaks on the web pages were introduced to better the readability of the text. Logic-based inquiries were avoided because they could do answering defeat and increase the drop-out rate. Study was done to happen any serious loopholes and if inquiries were genuinely answerable. 3.

3. Organization of the QuestionnaireThe completeness of the questionnaire and the figure of responses were of greatest concern. Equally of import, the acknowledgment of respondents sing the benefits and utilizations of this research survey was besides of involvement.

In response to these concerns, the questionnaire design procedure began with designation of the undermentioned standards:

Questionnaire Response Rate

Accuracy Time Relevant Ease of

Completion Completeness Understanding Thoroughness and efficiency were achieved with an scrutiny for truth and completeness of the relevant inquiries, taking into consideration old surveies and Table 2. 1. The efficiency of the questionnaire, nevertheless, did non vouch a high response rate.

It was of equal importance, so, to guarantee that the questionnaire allowed the appropriate clip frame for respondents to reply and return it to the research worker. Based on the research worker ' s experience and the pilot study, the response clip was set at 15 proceedingss, and the respondents had 6 hebdomads to finish the questionnaire. Simple but effectual inquiries were asked, and different subdivisions of the web-survey questionnaire were created with distinguishable colourss to help the respondents in right replying and expeditiously trying the questionnaire. 3. 4. Questionnaire The questionnaire design procedure proceeded on an synergistic footing with inquiries being classified into two chief subdivisions: respondent profile and estimated loss of productiveness due to assorted field breaks.

Questions in the respondent profile were created to roll up information such as occupation place, work and supervisory experience, typical work locations, and contact information. While non straight turn toing productiveness loss issues, these inquiries were of value to the research by

allowing an analysis of productiveness loss issues across a assortment of different profiles in different parts. It was sensible to anticipate that a vicinity can hold an impact on the loss of productiveness due to assorted field breaks, particularly weather or environment. The concluding set of inquiries (Appendix B) , refering a loss of productiveness, straight targeted the factors impacting labour productiveness in the five different groups. The questionnaire included the list of productiveness factors. Respondents merely equipped factors impacting productiveness for each given standard status. Therefore, each respondent was expected to choose merely one option for each factor. The responses were based on the general cognition and experience of the respondents and were non related to any specific undertaking.

This simple and direct attack was chosen to set up a agency of developing a list of factors impacting labour productiveness in edifice building. 3. 5.

Pilot Survey and Questionnaire RevisionTo better the questionnaire development procedure, a pilot study was conducted. This phase consisted of several stairss, including designation of beginnings for informations, aggregation of informations, and decisions. The execution of lessons learned from this subdivision significantly benefited the questionnaire development. The 155 questionnaires shown in Table 2. 2 were sent by electronic mail to labourers, contractors, architectures, proprietors, undertaking directors, and undertaking applied scientists from assorted constructing building organisations. Respondents were expected to finish the questionnaire within 2 hebdomads. A sum of 25 questionnaires were eventually gathered from

pilot study, 5 of which were uncomplete or outliers. The uncomplete responses and outliers were removed from the information set, go forthing a sum of 20 respondents in the database.

Lessons learned from carry oning this pilot study are stated below, and they improved the concluding questionnaire. The first portion of the questionnaire should be general information about the organisation. There are some inquiries which are non practical or realistic with regard to construction-project state of affairss.

Such inquiries should be removed or modified to stand for realistic and practical state of affairss. Some factors should be rearranged in order to give more suited and consistent significance. Some factors and sentences should be modified or represented with more inside informations.

Some factors are repeated with same significance. The excess factors should be eliminated. Some factors and sentences should be modified in order to give clearer significance and apprehension. Findings from the pilot survey strengthened the questionnaire bundle.

The betterments related to the, organisation of the questionnaire and the response clip. In footings of organisation, the web study was created utilizing a light visual aspect and pleasant-looking fount colourss. It besides included a per centum saloon for the completed study and had an option to voyage to any inquiry at any given clip. All the information entered via the web had an auto-save option and the respondents had the luxury to return to the study

within the allotted clip period. Respondents were informed about the confidentiality of the responses.

The list of inquiries used for the web study can be found in Appendix B. 3. 6.

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

mark groups in this survey were professionals from the building industry.

Harmonizing to Kish (1965) , the sample size can be calculated with the undermentioned equation for a 94 % assurance degree (Assaf et al. , 2001 ; Israel, 2003 ; Moore et al. , 2003) : Equation 3.

1Where, N = Total figure of population N = Sample size from a finite

population $N' =$ Sample size from an infinite population = S^2/V ; S^2 is the discrepancy of the population elements and V is a standard mistake of the

trying population. (Normally, $S = 0.5$, and $V = 0.06$.) A list of 255 edifice

cconstruction organisations was obtained from the Engineering News-

Record: $n = n' / [1 + (n' / N)]$, $n' = S^2/V = (0.5)^2 + (0.06)^2 = 69.44$ For $N = 255$ $n = 69$.

$44 / [1 + (69.44 / 255)] = 55$ It was calculated, the questionnaire should be

distributed to 55 organisations in order to accomplish a 94 % assurance

degree. Chapter 4. ANALYSIS AND DISCUSSION OF RESULTS 4. 1. Datas

Collected from the Web Survey Data aggregation is considered the of import

phase in garnering all required information from the cardinal in

accomplishing the chief aims of the survey.

Data aggregation can be defined as a procedure of piecing primary

informations records for a certain sample or population of observations

(Bohrnstedt and Knoke, 1994) . A sum of 255 questionnaires were sent to building professional through electronic mail in early October 2009. By the return deadline, a sum of 54 questionnaires were received, ensuing in an about 21. 11 % response rate (Table 3. 1) . Missing informations normally occur when a respondent decides non to reply a inquiry or when the reply given by the respondent has been discarded (Kim, 1993) .

The most serious concern presented in the responses was some missing informations. Follow-up contact was conducted over the phone to clear up some equivocal responses. A sum of 26 (i. e. , 10. 19 %) shut-in informations were found and accordingly discarded from the analysis.

The ground to fling the information was incompleteness and invalid responses. 4. 2. Measurement of Data collected from the Web SurveyIn the building industry, it is universally accepted that field breaks can be present at any clip with different grades of hardship. In an attempt to cover with these different grades, it was decided that four status degrees would be established: non applicable, does non impact it, slightly affects it, and straight affects it. These qualitative status degrees so necessitated the development of standard conditions. A clear specification of the standard conditions was necessary to enable respondents to clearly separate the grade of each inauspicious status degree. Standard conditions mentioning to four different grades of badness for each field break were ab initio established by Dr.

Eric Asa, Dr. Y. K. Yates, and the research worker.

The construct of different grades of badness for productiveness factors was antecedently used in other surveies, including Mechanical Contractor of America (1976) and Neil and Knack (1984) . Minor alterations were made to the standard conditions after they were reviewed by the group of building participants. Straightforward and simple guidelines for each group were so identified. A questionnaire to measure the loss of productiveness was developed following. In order to be able to choose the appropriate method of analysis, the degree of measuring must be understood. For each type of measuring, there is (are) (an) appropriate method (s) that can be applied. In this research, ordinal graduated tables were used. An ordinal graduated table, as shown in Table 3.

2, is a superior or a evaluation of informations that usually uses whole numbers in go uping or falling order. The Numberss assigned (1, 2, 3, 4) neither indicate that the intervals between graduated tables are equal nor do they bespeak absolute measures. They are simply numerical labels.

Based on a Likert graduated table, we have Table 3. 2 (Cheung et al. , 2004 ; Iyer and Jha, 2005 ; Ugwu and Haupt, 2007) . Table 3.

2. Ordinal Scale Used for Data Measurement

Item

Not applicable

Does non impact it

Slightly affects it

Directly affects it

Scale

1

2

3

4

4. 3. Analysis Method Used In order to ease the survey, after the literature reappraisal and the focal point interviews, a program was formulated for roll uping field information and making an rating procedure and numerical values. It was necessary to supply straightforward communicating to respondents to guarantee a clear apprehension of all the applicable definitions, processs, and guidelines that were used in roll uping informations.

Because the informations aggregation procedure included persons, the survey was conducted in conformity with the ordinances of the Department of Health and Human Services, the Food and Drug Administration, and North Dakota State University (NDSU) Policy # 345 under the supervising of the NDSU Institutional Review Board (IRB) . A structured study attack was considered to analyze the impact of assorted testimonials and factors

impacting public presentation. In add-on, the questionnaire can help with analyzing the attitude of proprietors, advisers, and contractors about the factors that affect public presentation in the building industry. The RII index method (RII) was used to find assorted professionals ' perceptual experiences of the RII in building undertakings. The RII index is computed as follows (Cheung et al.

, 2004) ; (Iyer and Jha, 2005) ; (Ugwu and Haupt, 2007) :

, Equation 4. 1

W is the weight given to each factor by the respondents and scopes from 1 to 4W ranges 1 Not applicable. 3 Some what affect it2 Does non impact it. 4 Directly affect it. A- Number of respondents for each gradeA Highest weight = 4N is the entire figure of responses collected for the ordinal graduated tableIt indicates that a deficiency of labour experience has an highly high consequence on productiveness. This consequence is supported by (Paulson 1975) , who found that the craftsmen ' s experience affects labour productiveness.

This consequence is besides supported by (Heizer and Render 1990) , who confirmed that the experience of the work force affects job-site productiveness. This consequence is justified because experience improves both the rational and physical abilities of labourers which, accordingly, increase labour productiveness. Labor disloyalty had a high consequence on labour productiveness and ranked in the 7th place for the work force group,

with an importance index of 373. 75, and 39th among all 40 factors in footings of negatively impacting labour productiveness (Table 4. 9) .

Misconstruing among labourers was ranked 4th in Manpower group, with an RII of 419. 75 and 32nd among all 40 factors that affected labour productiveness (Table 4. 9) . This consequence is justified because misconstruing among labourers creates disagreement among them about the duties and work bounds for each labourer, which leads to a batch of errors in work and, accordingly, decreases labour productiveness. A deficiency of competition among labourers ranked 6th with an RII of 379. 50 and ranked 38th among all 40 factors for negatively impacting labour productiveness (Table 4. 9.

) . Laborers age was ranked 5th in Manpower group, with an RII of 408. 25, and 34th among all 40 factors for negatively impacting labour productiveness (Table 4. 9) .

(Heizer and Render 1990) supported this consequence, mentioning that the age of the work force affects job-site productiveness. This consequence is justified because labour velocity, legerity, and strength diminution over clip and contribute to reduced productiveness Labor absenteeism was ranked 2nd in Manpower group, with RII of 477. 25, and in 18th place among all 40 factors that affect labour productiveness (Table 4. 9) . This consequence is justified given the transeunt nature of the local work force and the easiness with which building contractors could engage extra labourers to cover absenteeism. Personal jobs were ranked 8th in Manpower group, with an RII

of 368. 00, and 40th among all 40 factors that affect labour productiveness (Table 4.

9) . This consequence might be justified because personal jobs cause mental distraction for labourers, and mental distraction affects labour safety more than labour productiveness. Alcoholism ranked 3rd in Manpower group, with an RII of 425. 50, and 30th among all 40 factors that affect labour productiveness (Table 4. 9) . It can be justified because devouring intoxicant at the building site may take to assorted negative effects on other labourers who are working. Alcohol ingestion may take to make over, mislaying the occupation work, and accidents, therefore wholly or partly halting the building work and impacting the labour productiveness. 4.

10. External Factors Affecting Labor ProductivityTable 4. 5. and Figure 4. 2.

Illustrates the ranking of the factors for the External group. Supervision holds were ranked foremost in External group, with an RII of 488, and 13th among all 40 factors that negatively affect labour productiveness (Table 4. 9) . Inspection delays from the governments were ranked 6th in External group, with an RII of 448. 50, and 22nd among all 40 factors that affect labour productiveness (Table 4.

9) . Past survey (Guhathakurta and Yates. , 1993 ; Olomolaiye et al. , 1996) proves that review holds are an indispensable procedure in work ; for illustration, because contractors can non project concrete before review of formwork and steel work, the review hold contributes to detain in work

activities. It stops work wholly for activities that require the attending of supervisors, such as projecting concrete and backfilling.

Additionally, it delays the review of ready work which, in bend, leads to a hold in the beginning of new work. Variations in the drawings were ranked 2nd in External group, with an RII of 488. 75, and 14th among all 40 factors that affect labour productiveness (Table 4.

9) . Incomplete drawings were ranked 3rd in External group, with an RII of 483. 00, and 16th among all 40 factors that affect labour productiveness (Table 4. 9) . Design alterations were ranked 5th in External group, with an RII of 465, and 21st among all 40 factors that affect labour productiveness (Table 4.

9) . A complex design in drawings ranked 8th in External group, with an RII of 437. 00, and 20 seventh among all 40 factors that affect labour productiveness (Table 4. 9) . (Thomas et al 1999) stated that there is a 30 % loss of efficiency when work alterations are being performed. This consequence can be interpreted as alterations to specifications and drawings that require extra clip for accommodations of resources and manpower so that the alteration can be met. Besides known as interior decorator mistakes and skips, these alterations relate to programs that are uncomplete or contain mistakes that are hard to happen until the building contractor finds them good after the building stage of the undertaking has started. With most building contracts, where the contractor commands on designs that are

completed anterior to contract award, the proprietor is apt for the interior decorator ' s mistakes and skips.

Payment holds were ranked 7th in External group, with an RII of 442. 75, and 24th among all 40 factors that affect labour productiveness (Table 4. 9) .

Payment delays in the building industry are adversarial and black.

Late payment affects a company ' s hard currency flow and may finally take to a company ' s insolvency. Seasonableness of payment is of import to besiege the hazard of the late-payment job. A survey by (Zou et. al. 2007) pointed out that project-funding jobs have been identified as cost-related hazards, time-related hazards, and quality-related hazards which can significantly act upon the bringing of a building undertaking. The hazard of delayed payment from the proprietor will impact the continuance and cost of the undertaking. These hazards cause the undertaking ' s cost to increase abnormally and, later, to detain the advancement of the undertaking Rework ranked 4th in External group, with an RII of 471. 50, and 19th among all 40 factors that affect labour productiveness (Table 4. 9) . Past survey from (Makulsawatudom, Sinthawanarong, 2004) confirms that rework is one of the major factors in the building industry to impact labour productiveness in edifice building. It besides lists rework as one of the critical factors set uping productiveness ; and provinces that Rework is due to unqualified craftsmen and supervisors. Execution of authorities Torahs was ranked 9th in External group, with an RII of 419. 79, and 31st among all 40 factors that affect labour productiveness (Table 4. 9) . For most undertakings, authorities governments refer to specific versions and building criterions of their design.

Sometimes, nevertheless, authorities governments, who have well-established written criterions for design and building, take to revise those criterions after the building has been awarded based on a old version, therefore impacting the overall labour productiveness of the edifice building. Training Sessionss were ranked ten percent in External group, with an RII of 414. 00, and 33th among all 40 factors that affect labour productiveness (Table 4. 9) . A past survey from (Samson and Lema 2002) , (Cheung et al 2004) and (Iyer and Jha 2005) states that individuals come ining the building industry straight from high school normally start as inexperienced or as labourers. They can larn from their occupation rapidly, by closely working with the experient people. Whereas, skilled labourers, such as carpenters, bricklayers, pipe fitters, and other building trade specializers, most frequently get their formal direction by go toing a local proficient or trade school or through an employer-provided preparation plan. 4. 11.

Communication Factors Affecting Labor ProductivityTable 4. 6. and Figure 4. 3. Shows the ranking of the factors for the Communication group. Change order from the DE ranked foremost in Communication group with an RII of 465. 75, and 20th among 40 factors impacting labour productiveness (Table 4. 9) . Disputes with the DE were ranked 4th in Communication factors with an RII of 396. 75, and 35th among 40 factors affect labour productiveness (Table 4. 9) . Misconstruing among the OW, CO, and DE ranked 3rd in Communication group with an RII of 431. 25 and 29th among 40 factors impacting labour productiveness (Table 4. 9) . This consequence can be justified because DE lacks are alterations that consequence from faulty or confusing facets of building designs and specifications which are non

discovered until the contractor begins working towards constructing what is shown on paper. As opposed to other types of alteration, design lacks are frequently the consequence of hapless quality control in the design procedure, and they are governable. The proprietor is besides apt for the contractor ' s costs due to designer mistakes, such as unreasonable holds in reexamining store drawings, failure to supply drawings or design information in a timely manner, failure to turn out timely reviews, and other holds due to the interior decorator ' s contract-administration jobs (Bramble and Callahan, 2000) . Harmonizing to surveies by the U. S. Army Corps of Engineers and the U. S. Navy, design lacks account for about 40 % of all building alterations on a design-bid-build undertaking, more than any other class of alteration. 4. 12. Resource Factors Affecting Labor ProductivityTable 4. 7 and Figure 4. 3. Shows the ranking for the factors of the Resource group. Lack of needed building stuff was ranked foremost in Resource group, with an RII of 558. 00, and 1st among all 40 factors impacting labour productiveness (Table 4. 9) . Inadequate building stuff was ranked 11th in Resource group, with an RII of 437. 00, and 28th among all 40 factors impacting (Table 4. 9) . An addition in the monetary value of stuff was ranked 7th in Resource group, with an RII of 396. 00, and 36th among all 40 factors impacting labour productiveness (Table 4. 9) . The stuff resource constitutes 40-60 % of the undertaking ' s entire cost (Damodara