

**DEVELOPMENT OF DATABASE SYSTEM FOR MANAGING
LABOUR RESOURCES ON CONSTRUCTION SITES**



FINAL YEAR PROJECT UG 2016

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CERTIFICATION

This is to certify that thesis entitled

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ABSTRACT

Labour have been the most effecting factor in construction industry throughout the history. Labour constitutes about 30% of the total cost of project. With the advancement in technology and modernization in project executions, it increased the efficiency of many factors thus neglecting labour. Construction industry in Pakistan is relying heavily on manual site management and paperwork for documentation especially in case of labour. With the advent of new era, new management systems are under consideration that can optimize labour data for the better and efficient utilization on mega projects thus construction project are there to create something.

The idea behind this project is to reduce the problems faced by labour through smart data management system. These factors are also a cause of work delay and loss of site productivity on construction site. All these factors are identified through previous research papers on different type of construction site.

After analyzing the literature and different factors, database framework was developed which included different information related to labour, including personal information, experience, and work information etc. For database purpose MS access software has been used.

Through this database site engineers and project manager can access data at any moment without getting into paperwork. Backup of this database is easy to made and accessed. Thus, it is user friendly and economically viable. This management system is socially acceptable which helps in reduce time for data access and improve the efficiency of labour in construction industry.

DEDICATION

We dedicate our thesis to our parents, teachers and most important of all our supervisor that lead us through the adverse pandemic and lead us to the results.

ACKNOWLEDGEMENT

We thank The Almighty Allah for a giving us the strength and belief in ourselves for undertaking this final year project. We also take the opportunity to express our gratitude and respect to our parents, without whose prayers and wishes we would never have been able to complete project.

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1. Introduction

1.1. Background Study

Efficiency in the construction industry is always given the utmost priority, which is on-time delivery of construction project with no cost over runs (Bowden, Dorr et al. 2006). Many research reports exhibit a significance relation between technology and project efficiency in construction industry, but in some fields of construction industry not much research has been carried out.

The construction industry is moving toward digitization. There is no alternative to digitization. Even on the building site, construction needs to catch up. Digitization is about organizations experiencing associated frameworks at each connection in the worth chain. It is tied in with operating systems to handle the mass amount of data and using that data to predict future projects with real time variations taking place. This comprehension is changing the job advances. They are never again insignificant instruments to assist organizations with doing likewise things somewhat better. Rather, they on a very basic level change the way business is finished. Late advancements in development and different parts of industry show that there is no halting the uber pattern toward digitization.

Time, cost, and quality are the key elements of every construction project. The triangle illustrates the relationship between three primary forces in a project time is the accessible time to convey the undertaking, cost speaks to the measure of cash or assets accessible and quality speaks to the fit-to-reason that the venture must make a progress. Thus, profitability assumes a key job in helping us keep up this triangle.

This Triangle is greatly influenced by considering the on-site issues and diagnosing trends of elements we come across. Few major parts that play vial role in controlling the project cost over runs are material, labour, and miscellanies (varying with project type).

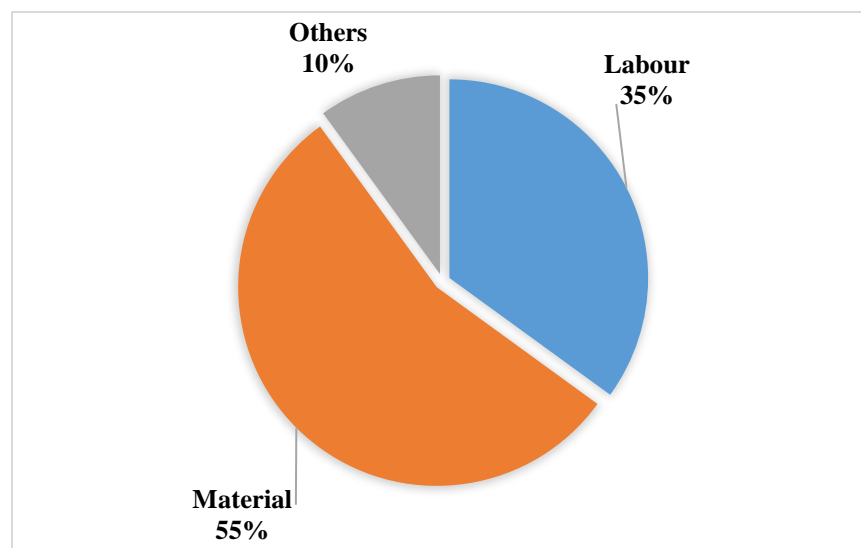


Figure 1: Three major costs of construction site ((Kamau, 2013)

Considering the labour part only exhibits that it has a high percentage in project control. Thus, most of the labour issues are related to mis management of labours ad project data relating them. Thus, creating loophole on project with large size or having multiple activities running simultaneously on site.

1.2. Impact of Modern Digital Techniques

As stated earlier, cost over-runs, time over-runs and poor communication are major problems in our construction industry. Developments have been made in this respect as construction industry has adopted modern tools like design software in place of manual drafting and drawing, software instead of manual cost estimation and planning but there is still room left for further development (Bowdden & al, 2006).

Use of modern software's and techniques will help us to improve

- Data handling
- Predict project variation
- Better resource management
- Reduction of project time
- Analyze projects of same nature
- Transfer of a project learnings to new engineers entering industry

1.3. Productivity

Productivity could be defined as “the ratio of output of required quality to the inputs for a specific production situation; in the construction industry” (Shah). Productivity in development ventures is typically a monetary measure which goes about as a distinct advantage. Efficiency can be a compelling component in limiting the task misfortunes or expanded benefits. Loss of billions of rupees consistently are happening because of misfortune or absence of efficiency. Notwithstanding different investigations has been done in the most recent decade, a more profound comprehension can assist with improving the efficiency. Productivity helps in accomplishing the most extreme conceivable proficiency and in this way can help to decrease time, exertion and so forth. Profitability can support an organization, increases upper hand and thin overall revenues. In simple terminology

$$\text{Productivity} = \frac{\text{Amount of work done}}{\text{Duration}}$$

Efficiency is one of the key segments of each organization's prosperity and intensity in the market. Efficiency makes an interpretation of straightforwardly into cost reserve funds and gainfulness. It is important to improve profitability consistently or hazard losing significant agreements.

There are several factors that affect productivity, partially or fully or in minor or major context.

These factors were pinned out from literature reviews of previous studies done till January 2020. The factors can be structured as major groups and under it lie the sub factors. A few of these variables are controlled by the proprietor, a few are controlled by the creator and a few are controlled by the temporary worker.

1. Material handling factors.
2. Execution of tasks and construction variables.
3. Equipment variables.
4. Design factors.
5. External factors.
6. Labour factors.
7. Financial factors.
8. Health and safety factors.
9. Organization factors.
10. Projects factors.

1.4. Labour Effecting Productivity

Construction projects are often labour intensive with basic hand tools and equipment because labour costs make up 30 to 50% of the total project cost (yates, 1993). Subsequently, there have been a few basic labour efficiencies inquire about thinks about, and as it were a couple of have tended to the issue of efficiency in creating nations.

There are thirteen important factors that affect labour productivity. Workforce skills, construction capability, monitoring quality, work ethic, incentive planning, site layout, complexity of construction information, staff size and structure, workday, availability of electrical equipment, number of activities and total number of work subcontracts identified.

In 1995, Lim and Alum categorized various factors affecting construction productivity in Singapore and listed the following five factors as the most important: lack of qualified supervision, shortage of skilled workers, high labour rates, foreign workers' labour absenteeism and communication.

1.5. Problem Statement

Construction industry in Pakistan is relying heavily on manual data systems for labour management. Due to which Labour faces issues in certain ways like payment delays, Leave Records, Age or language barriers & Job confirmations, lack of rest time etc. That ultimately effects site labour productivity, site management & quality of work thus causing the increase in project costs and waste of usable data with each project.

1.6. Objectives

Our objectives were planned with the vision of less labour-intensive data handling with the projects where use of modern-day technologies enhances the data management and record systems that are mostly manual operations taking place in today's sites. To achieve this goal the whole project was broken down to 3 steps involving the determination of factors to the development of system that could efficiently record and represent data for better management.

- i. Identify and analyze problems construction labour face on site relating to database management.
- ii. To develop strategies to counter mentioned problems through database management system.
- iii. To develop said database management system to mitigate labour problems on site.

1. Identifying Factors

First step involves the identification of factors and reasons causing the issues of labour productivity and quality off work on site thus increasing cost along with decreasing quality to the project and helping the later projects management. This step involved 2 approaches.

- Previous research was used to identify factors that were relating to labour directly or indirectly.
- Real time interviews identifying labour issues with site engineers, project supervisors, project manager and labour itself.

2. Creating Strategy

After identification and analyses of factors causing problems in labour productivity second part involves the development of strategies that could solve most of the identified problems and would be implementable on a framework to handle data and records.

- This step encircles majorly on the solutions suggested by site engineers, record keeper's ad project managers of a number of sites.

3. Development of Framework

This step involves the creation of system that could use existing data and will be able to input new data with time thus producing a comprehensible outlook that will be easy to manage and readily available to the require person.

- To develop a solution for the identified problems.
- Design a framework incorporating the proposed solution for real-time resource management.

2. Literature Review

2.1. Introduction

Multiple research papers have been consulted to pick up the major factors that were related to labour affecting productivity and work quality.

(Ee Lin Lim, 1995) studied factors affecting productivity in the construction industry in Singapore. His research indicates that the most important factor affecting productivity is the difficulty in hiring supervisors; Difficulty in recruiting workers; High rate of labour occupation; Absence from work site; And communication issues with foreign workers.

(Olomolaiye, Kaming, Olomolaiye, Holt, & Harris, 1996) studied the factors that affect the productivity of handicrafts in Indonesia, their findings show that handicrafts in Indonesia work 75% of the time. Five specific productivity problems were identified: material shortages; Work again; Shortage of equipment; And equipment.

Because work capacity governance involves work, company owners / models routinely appear to be center-level supervisors, with the responsibility of coordinating guidance from top-level directors for worker use. These directions affect the reduction of construction costs. In this way, labour can influence project-related factors in construction sites.

(al, 1819) The Administrator / Engineer is an important person in the company group who deals with the issues and choices of the authorities and this affects the development work efficiency. Therefore, the United States Agency for International Development (USAID) (2005) considers the project supervisor to be a jack of all trades because the role of project cost reduction or growth depends largely on their insights and encounters.

This paper reports on a case consider that included a bridge developed beneath antagonistic conditions. The major challenges confronting the temporary worker were clearly recognized through investigation. The bridge was built by a setup, experienced bridge temporary worker that confronted numerous overwhelming challenges within the developing of the Establishment of the bridge extending from over-design to the Extend Supervisor overseeing his to begin with development extend. In any case, the greatest challenge was unforeseen location conditions within the frame of a few of the foremost troublesome clay possible through which to drive heaps. These challenges constrained the temporary worker into a few strategic maneuvers. In sharing both the strategies adjusted by the temporary worker and the comes about of the adjustments, this paper measures for analysts and professionals how a great temporary worker made sound, crucial choices to overcome serious challenges and move forward efficiency rates mid-project to in the long run make the venture a victory. An appearing fiasco early on, the extend was inevitably completed in less than the contract term and at a sizeable benefit for the temporary worker (Minchin, 2015).

2.2. Research Paper Analysis

Here we have discussed the papers that consider these problems as a source of inefficiency on construction sites.

Table 1: Factors mentioned in research articles

S.no	Factors	References
1	Hiring of unskillful and unspecialized labour/ lack of skillful labour	(cartwrig, Jones, Sadiq, Mahdi, & Rahim, 2011), (Jamies & George, 2016), (Kumar, Akhund, & Mahamid, 2013), (Odesola, 2013), (Gopal, 2016).
2	Lack of experience	(Mahdi, Crtwrig, Jones, Jamies, & George, 2016), (Kumar, Akhund, & Mahamid, 2013), (Odesola, 2013), (Gopal, 2016), (Aichouni, 2014).
3	Poor/miscommunication	(Mahdi, Hook, Jones, & Rahim, 2011), (Soekiman & George, 2016), (Shah M. P., 2014), (Kumar, Akhud, & Emsley, 2001), (Mahamid, 2013).
4	Wrong behavior of labour (work discipline)	(mahdi & Rahim, 2011), (kazaz, 2016), (Soekiman & George, 2016), (Shah M. P., 2014), (Kumar, 2011)
5	Non familiarity of worker with the program/ unclear instructions	(Soekiman & George, 2016), (George, 2016), (Shah M. P., 2014), (Kumar, Akhund, & Mahamid, 2013)
6	Lack of rest time during working day	(Mahdi & George, 2016), (Kumar & Emsley, 2001), (Mahmid, 2013), (Odesola, 2013)
7	Cultural disparities (lack of coordination)	(Jamies, Kumar, Akhund, & Emsley, 2001)), (Mahmid, 2013), (Aichouni, 2014).
8	Health and age	(Hook, Jones, George, & Sidique, 2016), (Kumar & Gopal, 2016).
9	Onsite disputes	(Hook & Rahim, 2011), (Kumar & Mahamid, 2013), (Aichouni, 2014).

S.no	Factors	References
10	Labour plan changes/ absenteeism (means labour will not come to work tomorrow without informing)	(Shah M. P., 2014), (Kumar, Akhund, & Emsley, 2001), (Mahmid, 2013), (Gopal, 2016)
11	Labour language issues	(Mahdi & Shah, 2014), (Kumar, Akhund, & Mahamid, 2013)
12	No labour prequalification	(Mahdi, Hook, & Gopal, 2016), (Aichouni, 2014).
13	Too many workers at the specific working site/ crew size	(Rahim, 2011), (Kumar & Emsley, 2001).
14	Individual productivity of the labour	(Mahdi, Kumar, Akhund, & Emsley, 2001)
15	Illiteracy/ lack of knowledge about modern technology	(Sidique, Kumar, Akhund, & Mahamid, 2013)
16	Mis understanding of required changes	(Mahdi & Shah, 2014), (Kumar, Akhund, & Odesola, 2013).
17	Payment delay	(Kumar & Gopal, 2016), (Aichouni, 2014).
18	Not proper data booking (management of information)	(Mahdi & Aichouni, 2014)
19	Digitization and modern equipment	(Kumar & Gopal, 2016)
20	Updated labour productivity rates	(Aichouni & erb, 2014)
21	Scarce labour	(Mahdi & George, 2016), (Shah M. P., 2014)
22	Wages not given on proper time to the labours	(George, 2016), (Gopal, 2016)
23	Laziness after waiting	Ibrahim M. Mahdi, Dr Ashok Kumar

2.2.1. Hiring of Unskillful Labour

This factor has been mentioned in many research papers and came out to be most affecting factor for labour productivity. There is no proper labour selection process in many places which lead to this problem.

2.2.2. Lack of Experience

With the growing construction industry in today's world need of labour has also increased. As more and more new labour is recruited, they do not have proper experience which ultimately affects productivity of labour on site.

2.2.3. Poor/Miscommunication

This problem is very common at site where huge number of labours is working especially from different areas. Obviously, many labours could not get proper education so they cannot speak many languages, so this problem arises.

2.2.4. Wrong Behavior of Labour (Work Discipline)

This factor is not commonly found on many sites, but it has huge impact on labour productivity. This not only affects project but also other labours, so this problem needs to be catered

2.2.5. Non-Familiarity of Worker with The Program/ Unclear Instructions

Main reasons for this factor are language issue and lack of experience. As new labour is hired, they do not know much about the construction process, so it is a bit hard to make them understand what they need to do. Same goes for the labour who work on large site but do not understand many languages.

2.2.6. Lack of Rest Time During Working Day

Rest is important after hectic tasks on construction sites but still some labours go for extra time to earn more money. Although that is good option but working for many hours continuously ultimately affects labour productivity.

2.2.7. Cultural Disparities

This problem arises where labour from different areas are working together. Although this not mostly happens but impact is huge. This factor effects other labours as well which ultimately affects project this decreasing productivity.

2.2.8. Health and Age

These are the factors which affects productivity to greater extent. A labour having health issues cannot perform well that a healthy labour and same goes for age. Labour between age of 25-35 years can do more physical work than an older labour.

2.2.9. Onsite Disputes

This factor occurs due to language issue, due to labour behavior or some other site problems. This not only effects 2 or 3 person but the whole environment. So, it is upon site engineer to look for solution to avoid such incidents.

2.2.10. Labour Plan Changes/ Absenteeism

This factor affects the performance badly as work could not be done according to the plan. So, this factor effects project for a long time. Proper planning for such changes must be made to avoid such events.

2.2.11. Labour Language Issues

This factor is one of the most common problem found on the projects where huge number of labours is working. Coordination is very important at site and without knowing or having communication barrier among labour this cause productivity badly.

2.2.12. No Labour Prequalification

This problem is very common nowadays as there is not proper selection system for labours on any construction site. Having a prequalification process can help company to identify potential labours who could be more helpful in increasing productivity on construction site.

2.2.13. Too Many Workers at the Specific Working Site/ Crew Size

Crew size effects productivity badly, although it is known that more crew size more rapid the work would finish but it is not true. For every work there is optimum number of labours at which productivity is maximum. Increasing labour than that can decrease productivity.

2.2.14. Individual Productivity of the Labour

Individual labour can affect productivity as well, which not only increases construction time but also effects performance of other labour. Through prequalification process a company can identify productivity of each labour and then can assign them work accordingly.

2.2.15. Illiteracy/ Lack of Knowledge About Modern Technology

This problem factor is mainly present in developing countries where labour do not get proper education. As in today's world knowledge about modern technology is important to make work more efficient and increases productivity so this problem need to be catered.

2.2.16. Misunderstanding of Required Changes

This problem arises due to communication barrier, lack of knowledge about the work. This not only affects labour but whole project as well as its severity index is high.

2.2.17. Payment Delay

This problem is not very common but has huge impact on construction project. Payment not given on time can result in misbehavior of labour and delay construction process.

2.2.18. Not Proper Data Booking

In most of construction projects information regarding project is managed through papers, well it is difficult to handle and backup is difficult to make. So, solution for this problem is to make a proper data management system which is easy to use, backup easy to make etc.

2.2.19. Digitization and modern equipment

Several factors lead to this problem including lack of education, lack of experience, lack of knowledge about modern tools etc. With growing construction industry this problem needs to be catered as this would lead to delay work and increase cost of project.

2.2.20. Scarce labour

In some areas labour is hard to find so this factor is mainly present in those areas, although its frequency is less but it has great impact on project as it delays work hence increases cost.

2.3. Factors Causing Labour Problems on Sites

Therefore, looking at building specialists and site supervisor’s impression of the overall impacts of elements influencing construction work efficiency will either uncover that there is understanding or not in the manner the two parties see how much profitability factors influence development work. Their understanding will help to accentuate factors that ought to be engaged upon to improve efficiency.

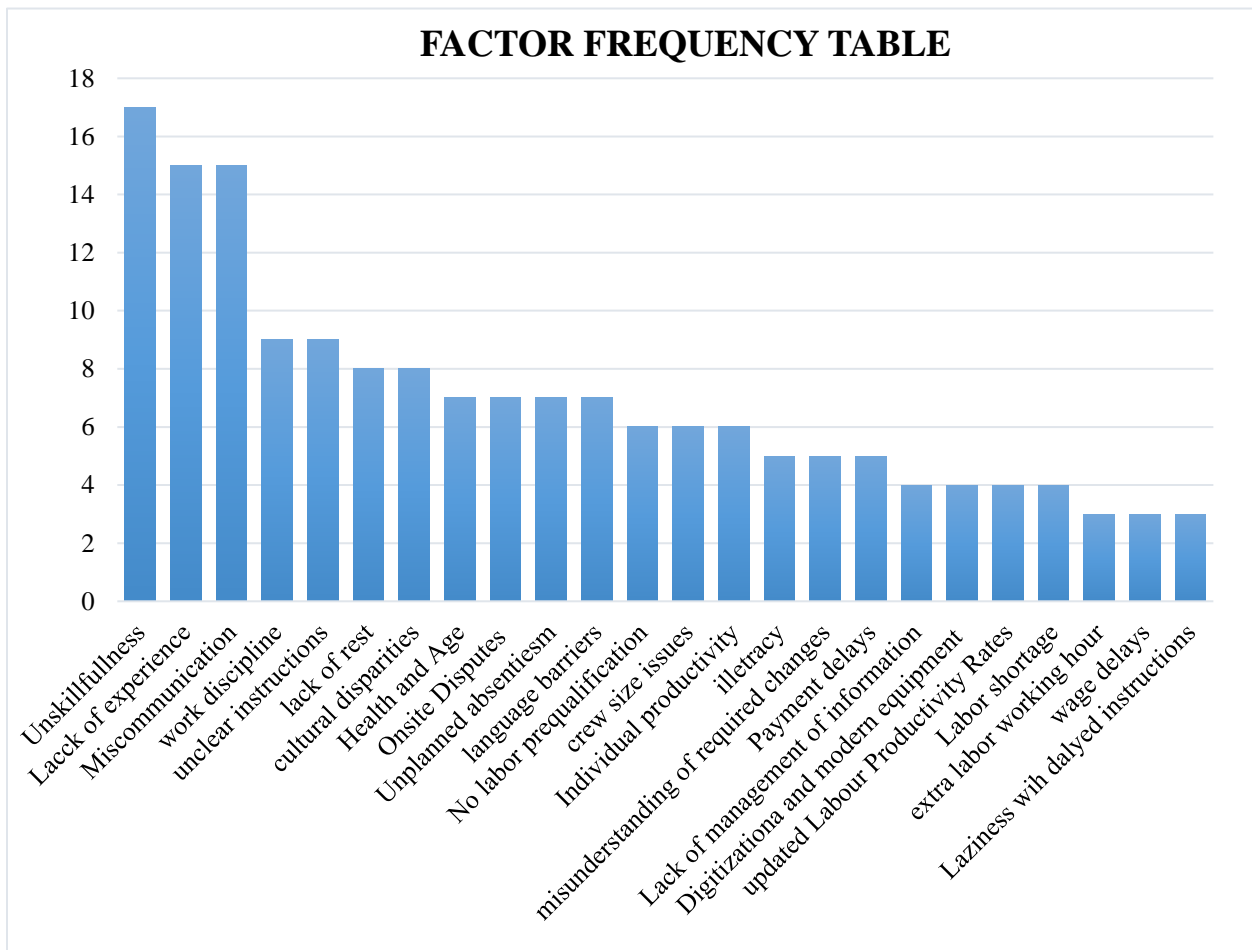


Figure 2: Frequency of factors in research papers

Site work efficiency is generally influenced by the administration of the work legitimately associated with on location exercises. Considering this, (Malonely, 1983) comment that create labour as the significant player executing work procedures and exercises to impact site work profitability.

Accordingly, the goals of this investigation are to: assess the overall impacts of task related elements from the point of view of building experts, assess the general impacts of venture related variables from the viewpoint of undertaking directors/engineers and to analyze building skilled workers' and undertaking managers'/architects' impression of the general impacts of venture related factors on development work profitability for understanding or contradiction.

Considering that project engineers represent higher management's views on factors affecting construction labour productivity their perceptions may be the same or different from that of the labours.

Based on above research done by different engineers and professors we have concluded several factors which are directly or indirectly affecting labours which in turn affect project productivity.

1. Hiring of unskillful and unspecialized labour for the specified job
2. Lack of experience in execution
3. Poor communication/ Miscommunication of tasks
4. Bad labour behavior (work discipline)
5. Non familiarity of worker with the program/ unclear instructions
6. Lack of rest time during working days
7. Cultural disparities (lack of coordination) mostly due to different work habits
8. Health and age factor
9. Onsite disputes among workforces
10. Absenteeism/ labour plan changes that are not communicated
11. Language barrier among working gangs
12. No labour prequalification
13. Crew size (too many labours at specific working site)
14. Individual productivity
15. Illiteracy/ Lack of knowledge about modern technology
16. Misunderstanding of required changes
17. Payment delays
18. Mismanagement of information
19. Less use of Digitization and modern management
20. Updated labour productivity
21. Labour shortage problem
22. Extra labour working hours without break
23. Laziness among work force after delay of instructions.

In contrast it can be seen and recorded from labours involved the productivity on site that the factors affecting this are completely overseen by the supervisors or engineers working with them. But the chances to this are very less. But if such factors are considered by engineer then we can approach for the resolution of such factors thus enabling us to improve the cost and time of projects. This must be considered on note that productivity factors are neglected on sites and short-term research cannot assess them because of data unavailability or more to say the mismanagement of data and facts that vary with each project.

2.4. Factor Frequency Analysis

Sites work related factors in this study allude to the arrangement of elements influencing site profitability inferable from the undertaking and subsequently could be viewed as venture visible on others. In contrast these variables could be particular to a project and may subsequently not be summed up for all activities. Twenty-three site or data related elements influencing development work efficiency were recognized from past studies and surveyed for their impact on development work profitability.

2.5. Data Analysis Methods

The collected factors were analyzed and ranked through the following statistical techniques and indexes.

2.5.1. Frequency Index value

This formula would be used to rank factors affecting labour productivity in public construction based on frequency of occurrence as identified by this.

$$\text{Frequency Index percent (\%)} = \sum f \left(\frac{n}{N} \right)$$

Where f = the constant denoting weightage given to each response (ranges is from 1, for very rarely, to 5 for always) , n = response frequency and N = total responses.

2.5.2. Severity Index value

This formula would be used to rank the identified factors as indicated by the literature.

$$\text{Severity Index percent (\%)} = \sum s \left(\frac{n}{N} \right)$$

Where s = the constant expressing weightage given to each response (ranges from 1, for very low, to 5 for very high), n = response frequency and N = total count of responses.

2.5.3. Importance Index value

The importance index of each factor is determined as a function of frequency and severity indices, as given by formula

$$\text{Percent Importance Index (\%)} = \frac{\text{Severity Index (\%)} * \text{Frequency Index (\%)}}{100}$$

2.6. Factor Selection

Factor selection was the most important step toward the required solution. As to enhance the solution effectiveness we used three indexes to pick out the solutions that are most effective and causing problems mostly on sites along with creating a relation with manual data management.

2.6.1. Categorization of Frequency

By applying the formula for frequency most commonly faced problems were scrutinized in relation to the record management of that factor and the possible solution through database management that could help us to resolve that issue in later stages thus playing a vital role in site management and labour related mismanagement issues. As discussed by the frequency we categorized factors in the following way by going from most occurred factor to the least appearance.

Most occurred factors that were also related to database were.

- Unskilled labour
- Labour experience in relevant tasks
- Task miscommunication
- Work Discipline /specialization of task
- Health and age
- Record of rest
- Individual productivity
- Language barriers
- Modern equipment handling skill

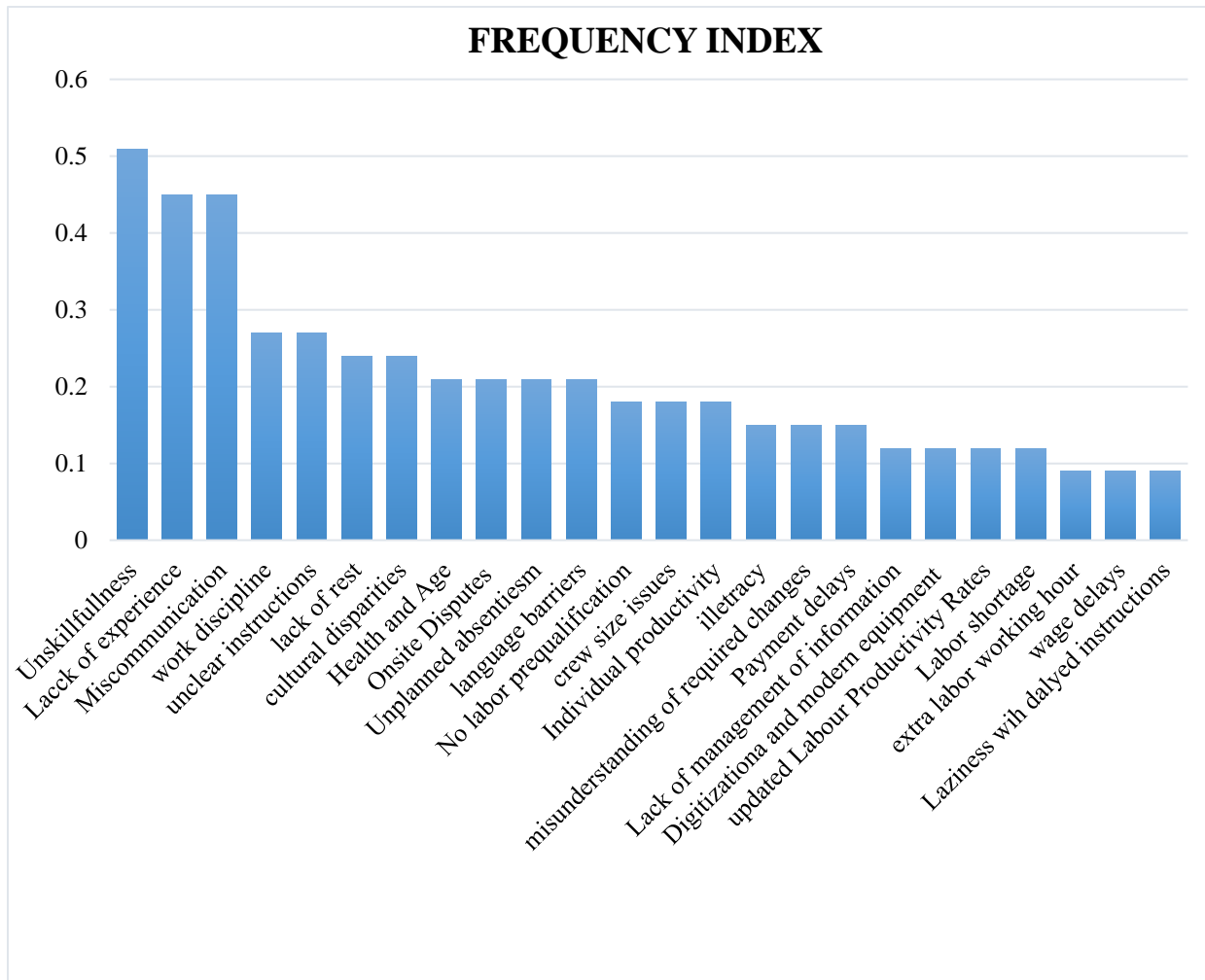


Figure 3: Relative frequency graph of factors

2.6.2. Categorization of Severity

Severity is mostly related to the effect of factor on project. It could be in terms of cost or quality of project or related to the humanly errors that may cause these phenomenon's in relation to the labour disputes that arises due to as such reasons.

So, the related table for such factors is given as.

- Unskilled labour
- Lack of work experience
- Less work disciplines
- Health and age factor
- Cultural disparities
- Miscommunication

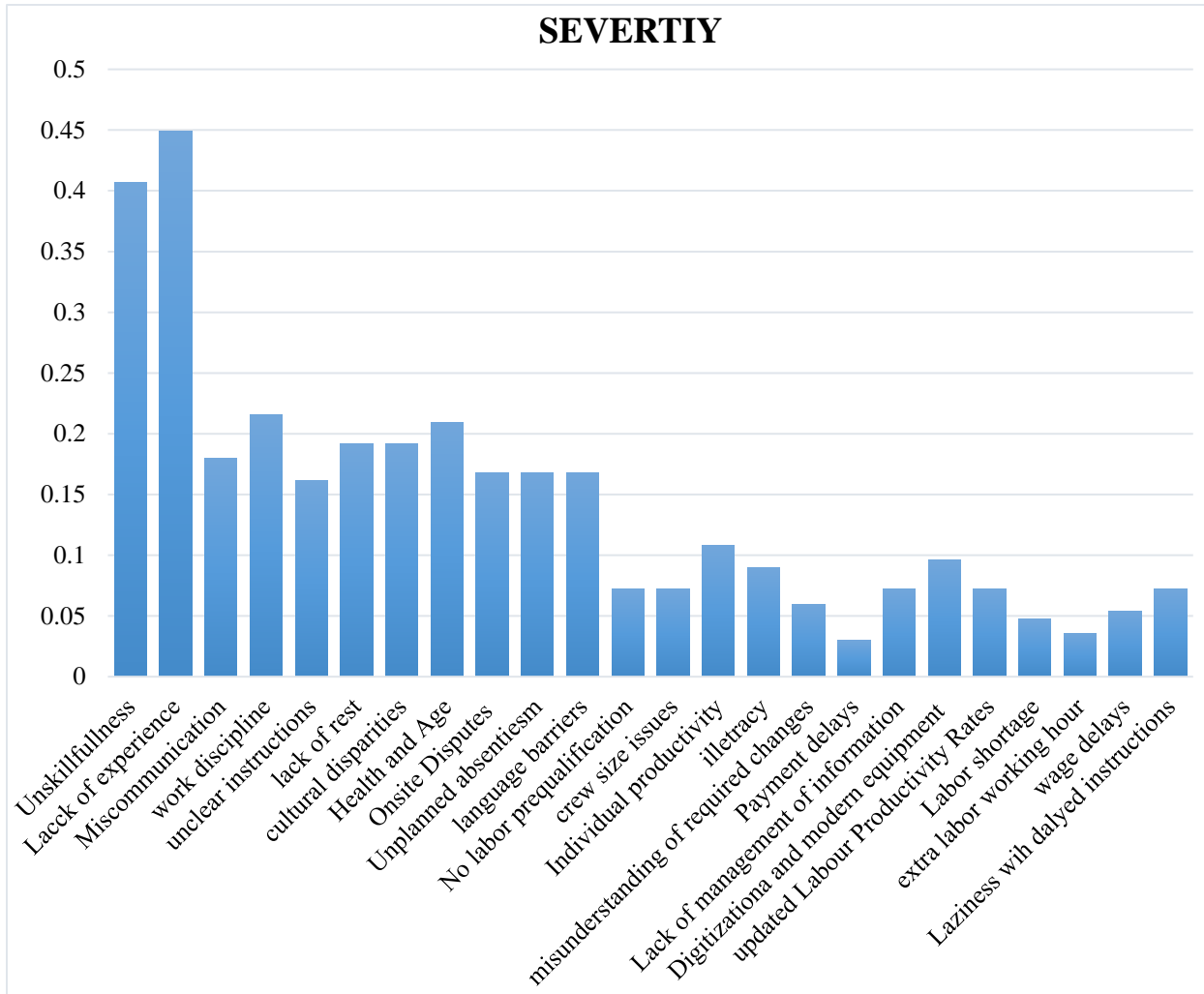


Figure 4: Relative severity graph of factors

2.6.3. Categorization of Importance

Importance index is important while pointing out the final factors that were to be resolved in terms of data base. So here we came across a very unfamiliar result that showed the effect of both severity ad frequency of each problem on project. The final table shows the relevant importance of factors below

- Unskilled labour
- Experience of labour
- Miss communication of tasks
- Health and age
- Language barriers

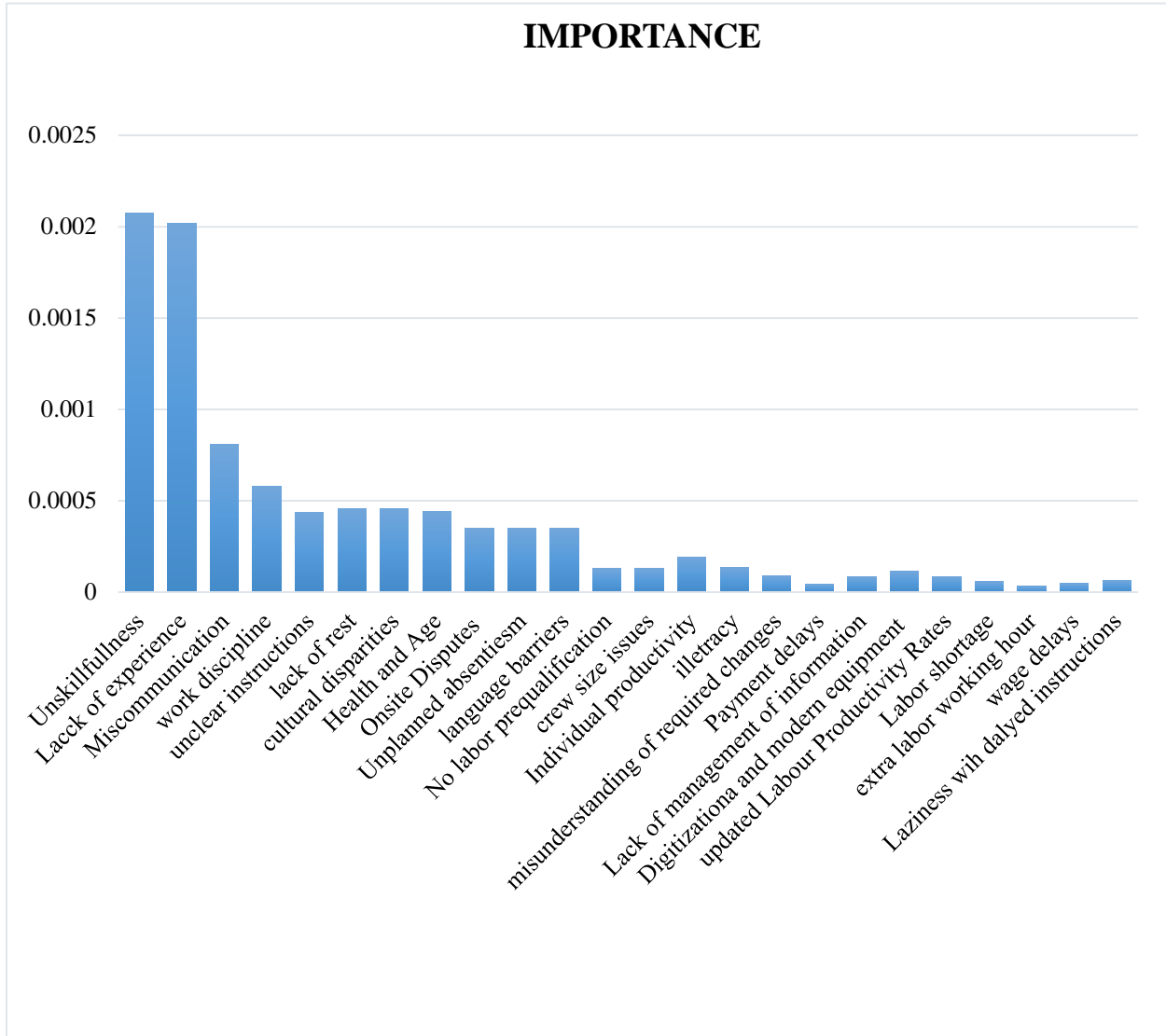


Figure 5: Relative importance graph of factors

2.7. Selection of Factors

Selection of the factors is the one of complex issues on basis of its importance. Next step involves the linking and data search of that factor to the existing sites of construction. This step takes place along with that of the possible method to resolve that issue through the digital database and hence decreasing the labour involved to record and then later represent data in comprehensible manner. So, we enlisted the reasons along with the reason of selection of each factor.

2.7.1. Rating system

At this step it is important to note that rating system involved here is on scale of 10. As it also helps to remove the neutral rating trend. Skill can also be rated out of 10 points that is thus the

most effective and important way of rating as concluded (Ganjalya, 2018)The table of rating will more likely starts from zero (0) no skill level to ten (10) exhibiting the mastery on skill.

Rating Scale will be in such a way,

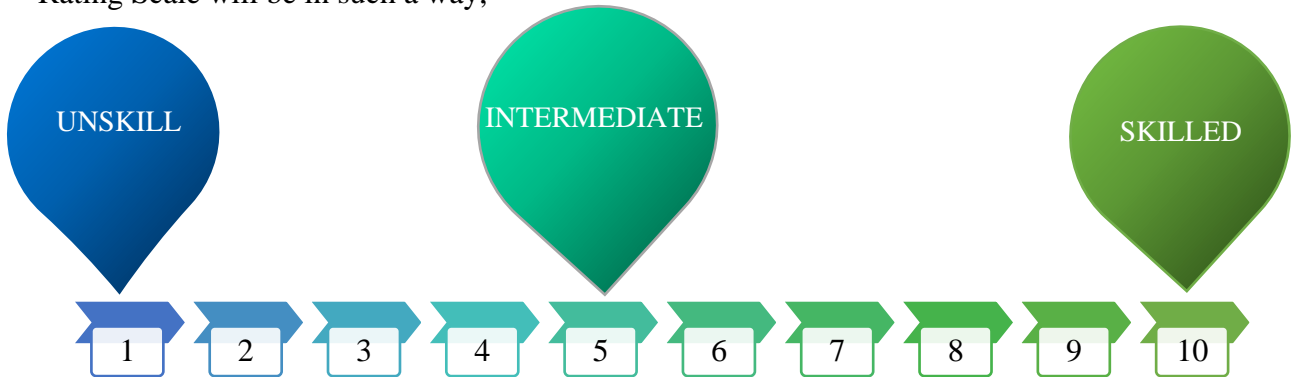


Figure 6: Rating scale used

2.7.2. Skill Level

To outline, we discover that higher capability and skill bungle are related with lower work efficiency, although the exact channel varies over the diverse sorts of jumble. The comes about are reliable with a body of existing prove which accentuates that underqualification and under-skilling are related with lower efficiency inside the affected firms. At the same time, be that as it may, unused experiences develop, which recommends that mismatch can antagonistically influence work efficiency by means of the allotment of work over a firm of changing efficiency levels (McGowan & Andrews, 2015)

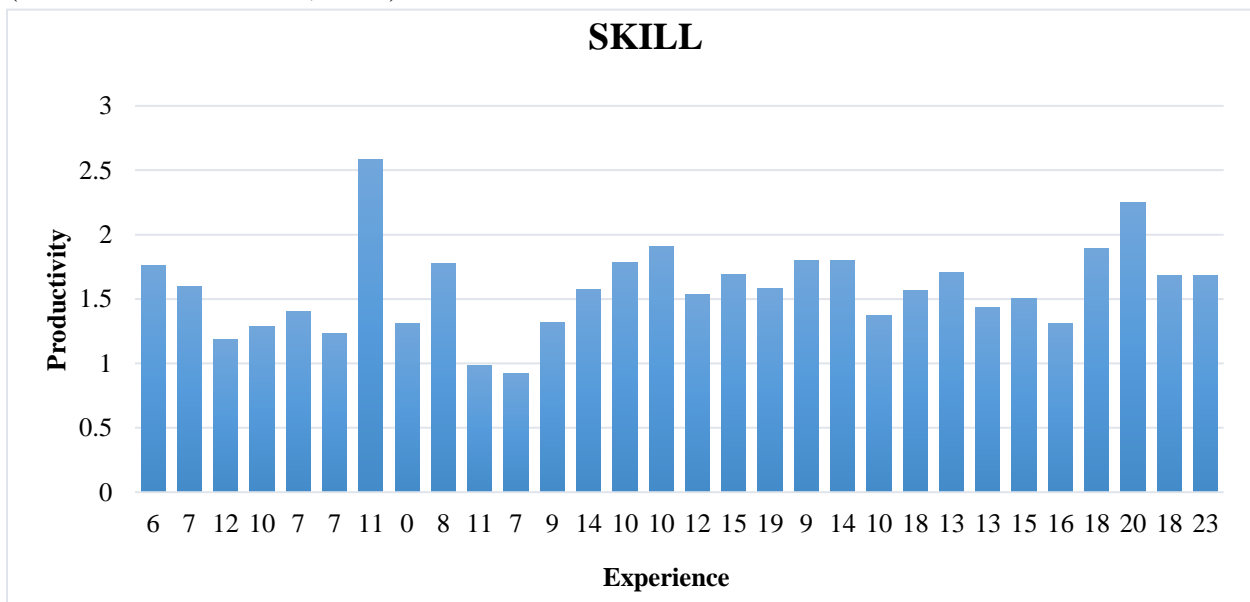


Figure 7: Relation of productivity with experience

This factor will be most helpful if we can divide the skills in two categories relating to the rating ad preference as it will also resolve the issue of multi skill workers who prefer to be diverse in conditions where they can earn more along with time utilization and thus provide productivity.

2.7.2.1. Major Skill

Major skill will be the one that is preferred by the labour or he is having any kind of certification in that skill thus making him stand out from others. We can add Major skill along with rating of that skill so at difficult time or emergency this data could help to resolve issues. Rating will take place out of ten-point system as explained earlier.

2.7.2.2. Minor Skill

Minor skill is a factor that is helpful in case of labour unavailability or the scenarios where sudden work force requirement is increased thus allowing the maintenance of higher productivity rates along with the higher quality of work thus maintaining and optimizing the project.

This skill can also be rated out of ten points relating to the level and integrity of skill in work.

2.7.3. Rate of Absenteeism

This is one of the factors that will help the supervisor or in charge that had to face some immediate changes on sites or on emergency tasks. Thus, bringing power to his hands to check and assign the short-noticed tasks to the workers who are more dedicated to such tasks and thus have high presence record. As in such scenario's issues are communicated on immediate basis and demands actions that may cause a lot of expense of resources. As a result, the project efficiency is compromised at this stage. This feature will enable to overcome cost overruns in such scenarios.

2.7.4. Wage History

This feature will also enable supervisors to check on the wage paid history or in some scenarios labour demands an advance that could be noted at the same management system thus making the site issues more efficient thus also resolving the labour delays issue. This will also be beneficial in the scenarios where labour demand or labour expenses are to be reported as each kind of labour have specific wage value that is related to its skill. Thus, at reporting time of labour quantity would be enough just to estimate the amount of allocated budget that is consumed in that specific task performance.

2.7.5. Age

Other factor is age, since human grows older. Generally talking, worker's vitality decreases by time of age. Hence, it may be a noteworthy factor in labour productivity. We need to see whether this figure will affect their efficiency or not.

While the research paper refers as the best ages of laborer's in construction are in their 30's. In this age, stable productivity is reached. On the other hand, young workers with less experience are ordinarily less profitable. (Bukit, Ismida, Maulana, & Muham, 2018)

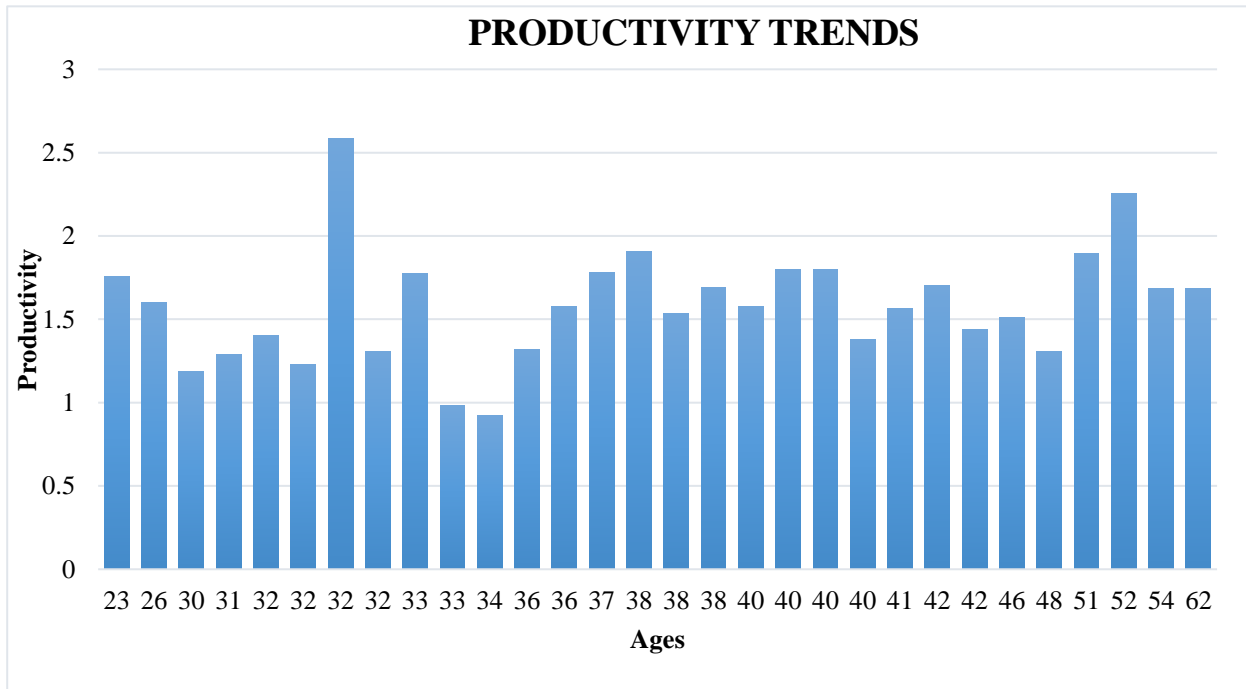


Figure 8: Relation of productivity with age (Bukit, Ismida, Maulana, & Muham, 2018)

2.7.6. Language

Language difficulties create a communication barrier that can lead to confusion, and misunderstanding, a common problem among immigrant workers (et al, 2010).

Numerous industries utilize migrant laborers to meet work requests not realizing the obligations of managers to guarantee that labourer's get it work dangers and security precautions.

2.7.6.1. Difficulty in Giving Instructions

- Giving instructions impacts all the other categories, particularly safety.
- Immediate activity instructions are about inconceivable to grant.

2.7.6.2. Greater Safety Risks

- Many workers come from a lacking safety conscious culture.
- Dangerous for all workers because they cannot warn each other of immediate harm.

2.7.6.3. Loss of Productivity

- Time is always compromised to teach or communicate with other language speaking workers.
- Demonstrations become more necessary even for simple tasks.
- More supervision is needed.

2.7.7. Work Discipline

Construction engineering is all about production and creating something valuable is the very reason for ventures to exist.

Working with individuals is one of the most excellent things in almost the construction industry and the foremost challenging! For most of our administration time we are centered on positive and beneficial assignments and endeavors. However, once in a whereas we discover that one worker who, after a few remedial endeavors, either does not get it the results or denies complying with our remedial informational. at that point we have to consider the discipline among others working nearby of that worker thus the best method to deal with such issue will be the rating helping us to understand the work discipline issues of individuals while assigning them to sites that require more discipline or less thus making the decision optimized for the condition and thus enhancing outcomes.

2.7.8. Supervisor Comments

This feature will enhance the overall performance and feedback system of the whole framework thus enabling us to deal with real time issues and thus further increasing the data usage. Thus, supervisor or site in charge may note and comment on specific issue or quality of labour thus enhancing the capabilities details of individuals.

2.7.9. Culture

Overseeing cultural differences in construction is vital for the success particularly in international ventures. Understanding and effectively managing cultural contrasts can give a few points of interest for project as well as company success. On the other hand, issues emerging from cultural contrasts can cause squander of assets and delay of construction.

Past studies and encounters within the construction industry enforced the fact that cultural contrasts effect day by day businesses, either negative or positive, of construction nationally or globally. cultural contrasts are hence an issue that cannot be overlooked in this industry and uncommon consideration ought to be given to the administration of cultural differences.

Cultural diversity management is defined as an organizational reaction to the need for competitiveness and to the increasing variety of the workforce (Fleury, 1999).

2.7.10. Last Qualification

Last Qualification means the most recent level of education as it will help to resolve the issue of miscommunication or wrong interpretation of tasks. Thus, it caters for the literacy rate check on labours.

2.7.11. Additional Factors

These are the list of few factors that are needed just for basic management of data and security reasons of sites. This list includes,

2.7.11.1. Name

The basic identity of any person working in an organization is the name as he will be recognized by this feature and mostly will help us to pin out cultural trend we have in workforce. This data will be added in terms of first name and second name of the individuals.

2.7.11.2. Contact Details

It will include the contact details like mostly used for fast communication on sites is the contact number or known as cell number of the person. It will also include the address of person in terms of four (4) categories as given, thus reaffirming the database worth and its usage over a wide period.

1. District
2. Tehsil
3. Home
4. Postal address

2.7.11.3. Identity Details

Identity details include any kind of official document number that can be helpful to prove your identity in judiciary will be helpful. As this process is purely security related and thus will also help to separate individual with similar other factors.

2.7.11.4. Emergency Details

As constructions sites are dynamic and several activities related to safety are running a same time. so, to handle any case of emergency or report any medical condition on time most important things the alternative contact details of the family of the person or any individual who ca help or take charge in that scenario.

2.7.11.5. Labour Code

Labour code will be used for the identification of individual in the developed system or interface thus helping to re access the data or search it out at any specific period that it needed.

2.7.11.6. First of Kin

This information will be helpful in scenarios of medical emergencies or if any kid of individual mishap happens on site. So that the family could be informed ahead of time. It will include the identity details i.e. CNIC and contact along with complete name.

2.7.11.7. Medical History

It will be as most of the modern era management system tend to record any kind of medical issues that a person may be facing. So, in case any medical situation arise the basic issue could be addressed first to increase the survival chances.

2.8. Analysis of Selected Factors

So, analysis is the step where we will finalize the possible solutions of factors effecting Projects in direct or indirect way by involving data mis management. So Most of the factors are those that are not being gathered yet as site executions take place manually or required details are

generally noted on paper in hard form that never get stored or used to analyze the parameter and stats for project. Use of a platform that can store and manipulate the data when required in required manner is important to analyze the end results and thus will help the decisions for optimized solutions. Wole purpose of study lies in this method as currently the systems are going more and more efficient and fast thus utilizing daily technologies that are accessible and easy to learn along with best results.

2.9. Software Used

By considering the complexity and basic earning capabilities that are acquired on construction site, Software selected to manage the data is Microsoft Access.

Microsoft Access is a database administration system (DBMS) from Microsoft that combines the relational Microsoft Fly Database Engine with a graphical client interface and software-development devices. It may be a member of the Microsoft Office suite of applications, included within the Proficient and higher versions or sold separately. Microsoft Get to stores information in its claim arrange based on the Get to Fly Database Motor. It can moreover consequence or interface straightforwardly to data stored in other applications and databases. Software developers, data architects and power users can utilize Microsoft Get to develop application computer program. Like other Microsoft Office applications, Get to is backed by Visual Fundamental for Applications (VBA), an object-based programming dialect that can reference an assortment of objects counting the bequest DAO (Information Get to Objects), ActiveX Data Objects, and numerous other ActiveX components. Visual objects utilized in shapex and reports uncover their strategies and properties within the VBA programming environment, and VBA code modules may pronounce and call Windows operating system operations.

In expansion to utilizing its possess database capacity record, Microsoft Get to moreover may be utilized as the 'front-end' of a program whereas other items act as the 'back-end' tables, such as Microsoft SQL Server and non-Microsoft items such as Oracle and Sybase. Different backend sources can be utilized by a Microsoft Get to Fly Database (ACCDB and MDB groups). Essentially, a few applications such as Visual Basic, ASP.NET, or Visual Studio .NET will utilize the Microsoft Get to database arrange for its tables and questions. Microsoft Get to may moreover be portion of a more complex arrangement, where it may be coordinates with other innovations such as Microsoft Excel, Microsoft Outlook, Microsoft Word, Microsoft PowerPoint, and ActiveX controls.

Microsoft Access is a general-purpose software operating system from Microsoft that combines the Microsoft Jet Database Engine with a graphical user interface and software development tools.

Not only does it provide an access form, it also provides features that make it easy for a person to record all those records. This makes data entry easier and faster and significantly reduces the margin of error.

The version used in setting up this database is Microsoft Access 2018

2.10. Benefits of Smart Management System

A major advantage of advanced labour administration is that project supervisors can get to each worker's data from the work site—or anywhere else—because the information is put away within the cloud. The information is spared and promptly accessible in case required for a future review or claim, killing the requirement for paper records.

This management system will integrate the records of labour and will reduce the issue of data management on sites and will be beneficial for the companies that require to manage labour data in mass amounts while optimizing their resources on each project to enhance the productivity. It will also be a positive part that will play a vital role in place where no record system is yet been introduced.

ICT integrates the communication amongst different departments and subunits of a construction organization and delivers rapidity of a data into information system (Sardroud, 2014).

2.11. Resources Used

1. Internet resources.
2. Lifestyle Residency construction project.
4. Microsoft and Adobe applications.
5. Industry members that served as interview participants.

3. Methodology

3.1. Introduction

The research strategy is expressive, perception and interviews. Age and experience observations are held in from 4 (four) project sites. This section explains steps involved in achieving the objectives and produce end results.

3.2. Methodology Flowchart

This study is based on method to solve on site productivity in an effective way. Around 23 variables that influence labour efficiency of construction location based on related writing of construction efficiency alongside the input and appeal by neighborhood temporary workers included in construction industry in Pakistan. So, after identification following steps were taken to resolve the problem.

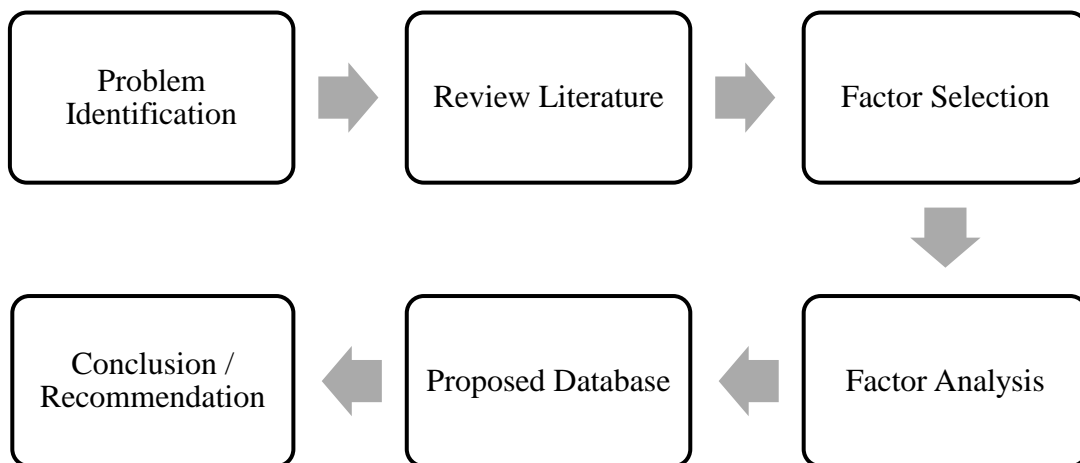


Figure 9: Steps involved to carry out research

3.3. Proposed Database

Proposed data base would be including all data factors as mentioned earlier thus providing an interactive interface for better user experience.

So, for the working of data base it been divided into three categories of

1. Input
2. Storage /Cloud Computing
3. Output

Each input is completely editable thus allowing any change from main page. Including the feature from Skill rating update system that will enable supervisor to easily update the skill ratings of labour on monthly basis.

3.4. Database Flow Chart

Database flow chart for the working of framework will be as,

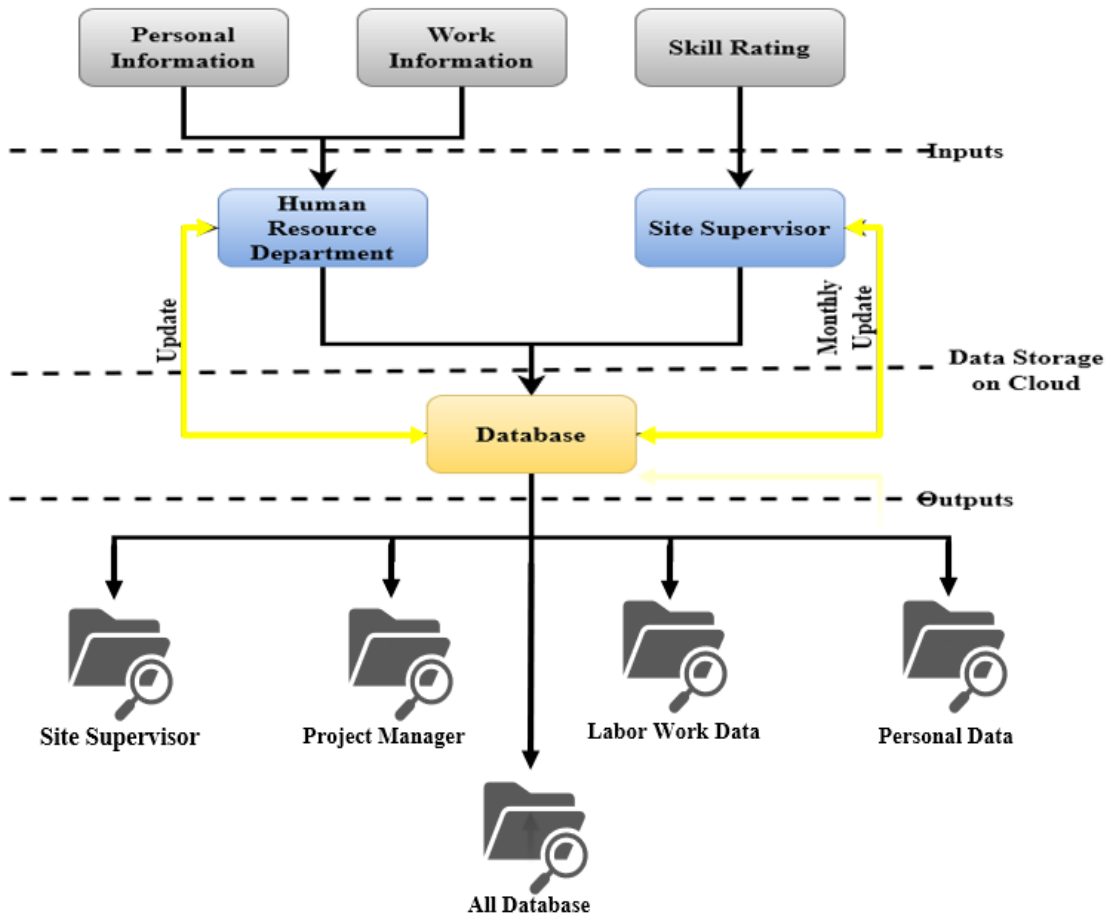


Figure 10: Flow diagram of framework

4. Result & Discussion

So, now after applying factors and their respective solutions that help to manage them . A framework is established that works on the logic expressed in flow diagram thus making data management more comprehensible and easier to understand.

4.1. Output Factors

Here factors with the modified solutions used in final interface are discussed along with the changes they may cause thus helping workforce management. Detailed discussion for each factor is done below,

4.1.1. Personal Details

Personal details i.e. First Name, Second Name, Age, address, and medical History are added along with the individual's picture to make interface interactive and more effective. As graphics and pictures are important part of database. The number of features included in his category are

1. Name
2. Identity number
3. Contact
4. Address
5. Postal Code
6. Medical History
7. Name of Next to Kin
8. CNIC Next to kin

4.1.2. Labour Code

Labour code is important to diminish the information overlap in scenarios where same name and addresses appear. Thus, everyone will hold a unique labour code that will help to access the required data at any time and thus enabling to manage mass amount of data.

4.1.3. Language

Language is added to resolve miscommunication and language barriers thus enabling individuals to put on places where they can be supervised and instructed effectively.

Language option is broken down further to three options

1. Mother language
2. Language able to speak
3. Language that could be apprehended

Thus, allowing the flexibility to be supervised or assigned on wide variety of tasks. Several languages are added in database, but any other option required could also be added later.

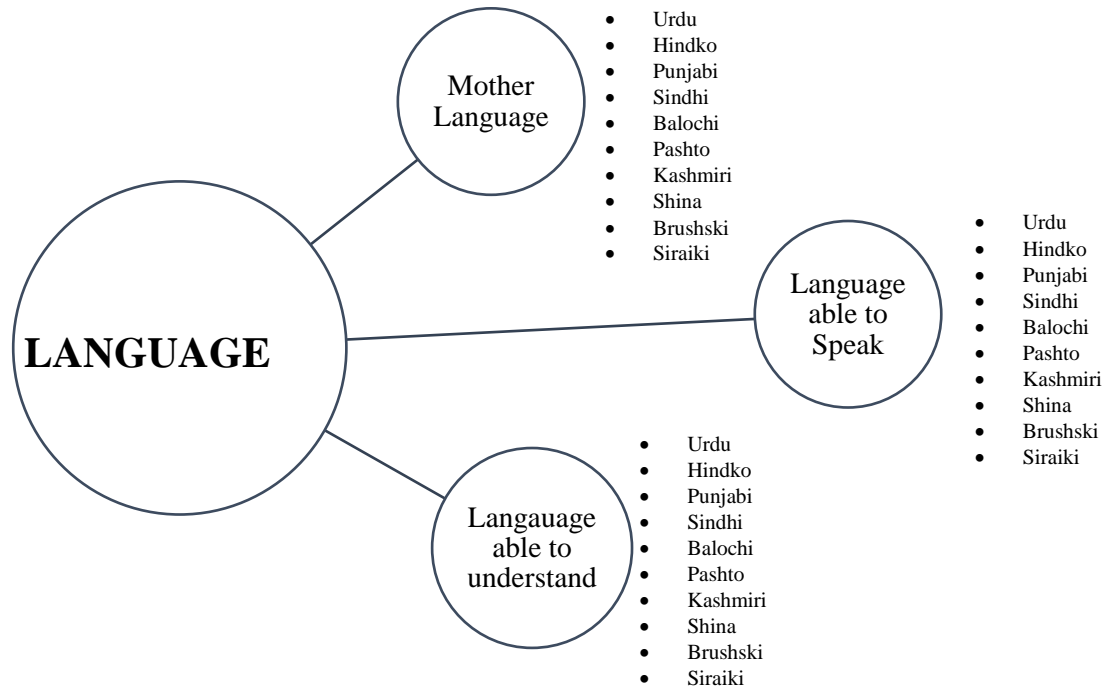


Figure 11: Language options in database

4.1.4. Work Type/Skill

This option will help to resolve issues related to skill and will result increasing efficiency with major and minor skills along with the rating system that is mentioned earlier.

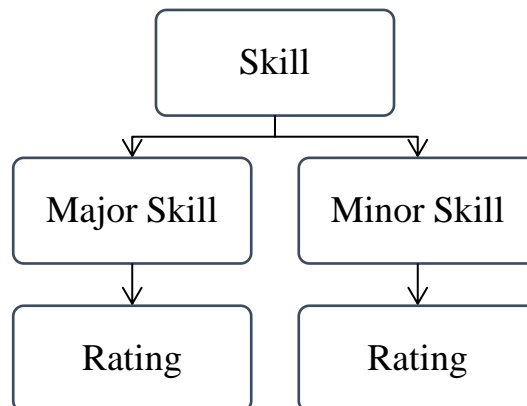


Figure 12: Skill Break down and rating logic

4.1.5. Productivity Rating

Productivity rating is important as the whole purpose of this research is to maximize the efficiency in sites. So, in this scenario productivity of individuals that is assessed by the supervisors

plays a vital role. So, the issues like slow work and less working hours could be resolved by them. This productivity rating was resolved by providing a productivity scale that helps us rate from low (1) to high (10) productivity. This rating will be carried out by the in charge on duty.

4.1.6. Experience

Experience plays an important role while performing tasks as seen by studies it increases efficiency on sites. So, the experience will also be noted in terms of years so that we may have the best knowledge about the work force’s potential on sites. It will be noted by the labour dealer. This option is further divided in two points,

- 1. Experience Field**

This experience involves the specific skill experience that a person may have served performing that is very much different from the second type.

- 2. Experience Tenure**

This experience is the value that may be utilized while performing odd jobs on site that have nothing to do with the efficiency related stuff.

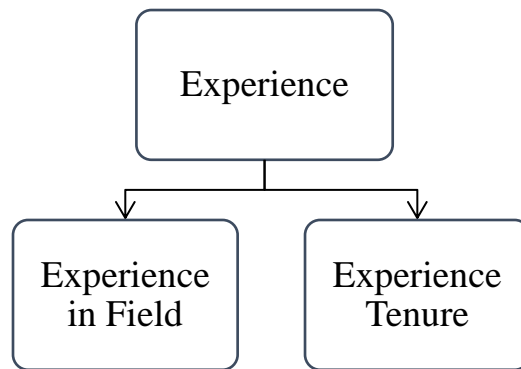


Figure 13: Categories of experience considered in options

4.1.7. Discipline Rating

Discipline rating is utmost important on sites where disputes arise on a daily basis thus it will play an important role while on such sites. The rating system remains the same from 1 to 10 where low=1 and high=10. This rating will be given by the supervisor of workers thus making this rating meaningful and much usable on later projects.

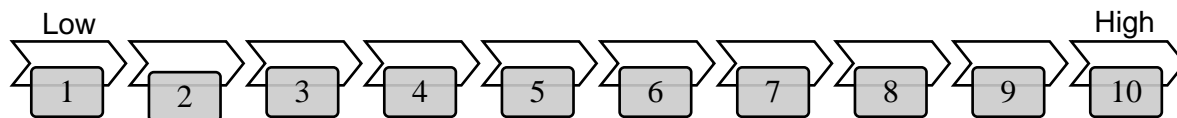


Figure 14: Rating scale for discipline on site

4.1.8. Overtime Willingness

This option is for these workers who are willing to be allotted extra hours of work thus receiving wage at modified rates or according to the company’s policy they are working with. This option will be binary as options will be in term of Yes or No only.

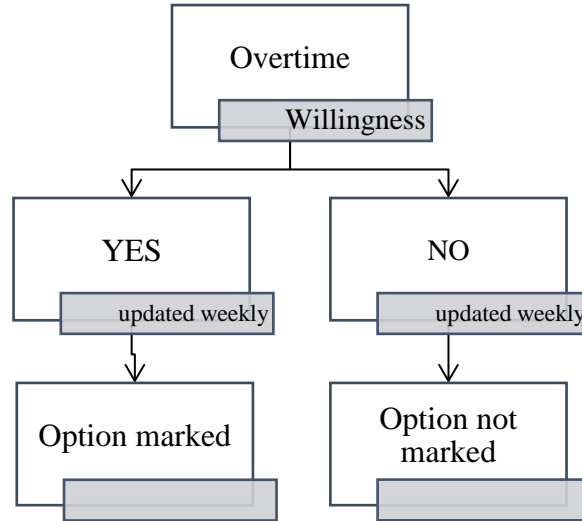


Figure 15: Binary logic for willingness

4.1.9. Absent History

Absenteeism is a factor that devastates the work progress as usually reporting time son sites are slow and thus till the labour absence is reported it already caused a loss of time. This happens specially in emergency tasks or unforeseen changes of work.

Absenteeism can be categories in 3 ways,



Figure 16: Scale for marking absent history

1. Low: Labour appears most of the time on site.
2. Medium: Half of the times labour do not appear on site.
3. High: Mean labour is usually absent from assigned task.

4.1.10. Wage per Day

This Feature enables to record and estimate the amounts paid to the variety of labours. Thus, while reporting a completion of task the cost occurred on labour could be verified by seeing the labour used with the amount total paid broken to per head.

4.1.11. Balance Wage

This Feature will allow one to check the standing wage history of labour thus allowing supervisor to maintain accounts as well at the same interface. As usually Labour is paid in advance before assigning any task that could be balanced Later on by working hours.

So, the standing wage could have two variations.

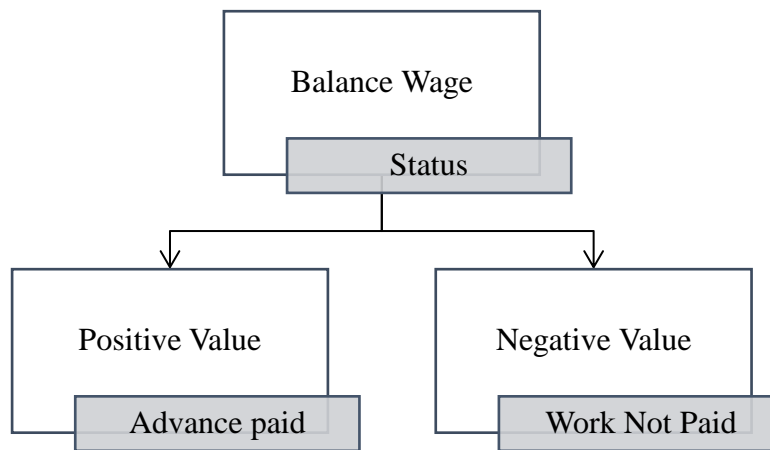


Figure 17: Wage payment breakdown

4.1.12. Supervisor Comments

Supervisor comments are necessary to be recorded as site conditions are forever changing and thus requires flexibility to record a variety of data that could be accessed later on for better decisions and thus helping those who are not on site to consider conditions while making decisions.

4.1.13. Last Qualification

This option is very much relating the miscommunication or instruction interpretations issues on sites Like most of the illiterate workers are unable to work in proximity of modern equipment thus decreasing work efficiency. This option will also pave path for any future research studies this allowing a space for improvement in management system.

4.2. Framework Interface

This this management system will address six (6) categories thus providing the relevant information to the designated authorities. An overview of Data Presentation is given below

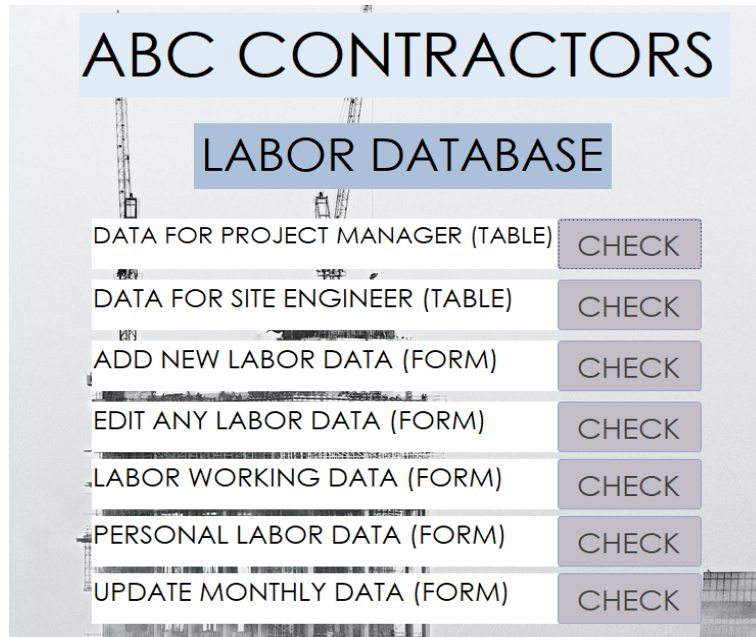


Figure 18: User interface for accessing database

4.2.1. Project Manager's Interface

Project Manager requires a different set of details while choosing to decide or assigning tasks so keeping that perspective inn view ,utmost information needed for him will be represented under his tab. Preview is given.

Labor code	First name	Age (yrs)	Mother language	Languages able to speak
001	Hammad	0		
Languages able to comprehend	Medical History	Home town/ City	Type of work	
	none		Mason, Steel fixer	
Discipline rating	wage (Rs)	History of absenteeism	Comments from Supervisor	Productivity rating
5				6

Labor code	First name	Age (yrs)	Mother language	Languages able to speak
002	Uzair	22	Punjabi	
Languages able to comprehend	Medical History	Home town/ City	Type of work	
	none		Mason	
Discipline rating	wage (Rs)	History of absenteeism	Comments from Supervisor	Productivity rating
10				10

Figure 19: Project managers tab for 2 labours data

4.2.2. Site Supervisor's Interface

Site Supervisor requires a different dimension of data set that will allow him to make on site decisions while assigning or assessing task to report to higher authorities.

Labor code	First name	Personal contact number	Age (yrs)	Mother language	Languages able to speak
001	Hammad	3369985632	0		
Languages able to comprehend	Home town/ City	Medical History	Type of work	Major skill	Major skill Rating
		none	Mason, Steel		2
Minor skill	Minor skill Rating	Experience (field)	Experience tenure	Productivity rating	Discipline rating
				6	5
Willingness for overtime	History of absenteeism	Last qualification	Comments from Supervisor		
<input type="checkbox"/>					
Wage per day (Rs)	Balance wage (Rs)				




Figure 20: Outputs visible to site engineers' interface

4.2.3. Labour Data Edit Interface

This Interface will help to edit new data in database or change any existing values as these will be required on monthly basis. Thus, this view requires all the data options used in database so they could be edited by the concerned person. All options here could be edited at any time and will show changes on other interfaces automatically.

Labor code	001	First name	Hammad		
Father name		Home town/ City		Age (yrs)	0
CNIC of labor		Postal Address			
Declared next of Kin		CNIC of declared next of Kin	13265489657		
Tehsil		District		History of absenteeism	
Personal contact number	3369985632	Emergency contact number	3365512458		
Type of work	Mason, Steel fixer	Medical History	none		
Mother language		Languages able to speak			
Languages able to comprehend		Willingness for overtime	<input type="checkbox"/>		
Major skill		Major skill Rating	2	Wage per day (Rs)	
Minor skill		Minor skill Rating		Balance wage (Rs)	
Experience (field)		Experience tenure			
Productivity rating	6	Discipline rating	5		
Last qualification		Comments from Supervisor			




Figure 21: Options available for data entry

4.2.4. Personal Labour Data Interface

This interface holds all the personal details of any worker. This view is important in case of any personal check or in emergencies thus allowing the important first decisions more helpful to the individual.


Labor code	<input type="text" value="001"/>		
First name	<input type="text" value="Hammad"/>		
Father name	<input type="text"/>		
CNIC of labor	<input type="text"/>		
Home town/ City	<input type="text"/>		
Tehsil	<input type="text"/>		
District	<input type="text"/>	Age (yrs)	<input type="text" value="0"/>
Postal Address	<input type="text"/>	Personal contact number	<input type="text" value="3369985632"/>
Mother language	<input type="text"/>	Emergency contact number	<input type="text" value="3365512458"/>
Medical History	<input type="text" value="none"/>	Last qualification	<input type="text"/>
Declared next of Kin	<input type="text"/>	CNIC of declared next of Kin	<input type="text" value="13265489657"/>
Languages able to speak	<input type="text"/>		
Languages able to comprehend	<input type="text"/>		

Figure 22: Labour personal data interface

4.2.5. Labour Work Data Interface

This interface gives a brief preview of work-related details including wage records, rates, and skills that a specific person is having thus this tab is completely related to site related information.


Labor code	<input type="text" value="001"/>		
First name	<input type="text" value="Hammad"/>		
Wage per day (Rs)	<input type="text"/>		
Balance wage (Rs)	<input type="text"/>		
Productivity rating	<input type="text" value="6"/>		
Discipline rating	<input type="text" value="5"/>		
Type of work	<input type="text" value="Mason, Steel fixer"/>	History of absenteeism	<input type="text"/>
Major skill	<input type="text"/>	Major skill Rating	<input type="text" value="2"/>
Minor skill	<input type="text"/>	Minor skill Rating	<input type="text"/>
Languages able to speak	<input type="text"/>	Willingness for overtime	<input type="checkbox"/>
Languages able to comprehend	<input type="text"/>		
Experience (field)	<input type="text"/>		
Experience tenure	<input type="text"/>		
Comments from Supervisor	<input type="text"/>		

Figure 23: Interface options related to work only

4.2.6. Monthly Updated Data Interface

This interface will cover all options that needs to be edited on monthly basis thus like productivity or willingness to take overtime are variable factors thus changing with the workers conditions. So, this interface will access such parameters and will help to update them with ease.

This is the second interface that is editable and thus allowing any change in database

Labor code	<input type="text" value="001"/>		
First name	<input type="text" value="Hammad"/>		
Age (yrs)	<input type="text" value="0"/>	Medical History	<input type="text" value="none"/>
Type of work	<input type="text" value="Mason, Steel fixer"/>		
Productivity rating	<input type="text" value="6"/>		
Discipline rating	<input type="text" value="5"/>		
Wage per day (Rs)	<input type="text"/>	Balance wage (Rs)	<input type="text"/>
History of absenteeism	<input type="text"/>		
Comments from Supervisor	<input type="text"/>		

Willingness for overtime

Figure 24: Options that require monthly update

5. Conclusion

5.1. Comment

Labour Management system is the one-time solution for those entering newly in labour-management or site supervision while enabling them to make decisions on facts rather than relying upon word of mouth. Also, the supervision and recheck processes will be evolved thus easing both sides of the table i.e. Supervisors, project managers and labour. With the advent of modern technologies in the construction industry to enhance the efficiencies by cutting costs occurring over mismanaged factors, the management system will be a chance to help resolve labour-related issues.

5.2. Industrial Contribution

This will be helpful in modern sites thus enabling them to play an effective part in the management and future research that will revolutionize the decision making and evaluation steps for sites and companies that will be using such methods.

Including the fact that usage of such systems in future will be very essential as highly efficient sites will be the foremost choice that all companies will desire to achieve. As with increased competition it is important to enhance the work quality by decreasing the cost occurred to achieve with highest efficiency to perform

5.3. Future Recommendations

This management system is based on purely on research outcomes thus there are places for improvement by conducting this systems through other languages like HTML or any other web language or enabling it through website that don't requires any stored code thus enabling individuals to view from remote places. As internet of things is emerging this management system could be directly integrated to the fingerprint scan system and account sheets thus decreasing the effort require to update fields mentioned. Further on more factors could be added that can occur in near future.

Not to forget that labour interface is one of the most important part that could be interlinked thus enabling new labours to register to the firm thus helping people to work on their will.

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