IMPLEMENTATION OF LEAN IN CONSTRUCTIN PROJECTS

(Izhar Construction (Pvt.) Ltd.)

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BAHRIA UNIVERSITY LAHORE CAMPUS

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SUBMITTED TO: Mr. Kamil Hassan

SUBMITION DATE: 11-Jun-2016

IZHAR
GROUP OF COMPANIES

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CERTIFICATE

This witness statement is issued to the applicants for the fulfilment of MS (Project Management) program requirements being carried out at Bahria University Lahore Campus (BULC).

It is witnessed that **Mr. Asif Iqbal & Mr. Abdul Majid** Enrollment: **03-298152-044 & 03-298152-001** respectively, Class: **MSPM-II_** Semester: **Spring 2016__**has contacted / visited / frequently utilized our company in our real-time projects for implementing of Lean concept in construction project management.

Both of them has contributed fully in the site visit and data collection from site and head office team for the following project(s).

1. Construction of Center for Advance Studies-Energy
2. Construction of Maternity Ward at JPMC Karachi

Furthermore they were found skillful in applying the concept of Lean and making proposal for Lean concept implementation in construction projects.

Additionally, it is noteworthy to mention that Mr. Asif Iqbal & Mr. Abdul Majid demonstrated good ethical practices, enthusiastic approach to work, task convergence capabilities, and professionalism while there stay connection with this Izhar Construction (Pvt.) Ltd.

Certified By Company Official:
(Planning & Reporting Engr.)

09-06-2016

Mr. Shahid Iqbal

Verified By Trainer:
(Signature & Date)

Mr. Kamil Hassan

ABSTRACT

Lean construction is the continuous process of eliminating waste, meeting or exceeding all customer requirements, focusing on the entire value stream, and pursuing perfection in the execution of a constructed project.

Over the past Forty years, the construction industry has seen a decline in both its share of the gross national product and its annual productivity growth rate worldwide. The quality of construction has faltered duringthis periodas well. In contrast, worldwide the manufacturing industry has made significant progress in increasing productivity and product quality while lowering product lead times.

The principles of lean theory are conceptualized at the process, project and enterprise or organization levels. Various principles, methods, and tools can be applied at each level, so that lean production becomes an inclusive philosophy aimed at continuously improving the entire production organization as well as the physical production process.

Essential features of lean construction include a clear set of objectives for the delivery process, aimed at maximizing performance for the customer at the project level, concurrent design, construction, and the application of project control throughout the life cycle of the project from design to delivery.

Lean principles proposed reducing variability to improve labor flow reliability and better productivity. 30% of construction is rework, in fact rework is the primary source of poor performance and productivity. In general, a very high amount of non-value added activities are existed. 3-6% accounts for accidents and 10 % of total cost of project accounts for material wastage, which makes a very high percentage of financial loss and time delays. Quality and schedules are also compromised due to wastages. Continuous improvement, production control, and continuous flow have been the direction of implementation of lean construction.

Lean philosophy, broadly defined, can apply to design, procurement and production functions. This report will discuss principles, methods, and implementation phases of lean construction showing the waste in construction and how it could be minimized.

Becoming lean is a long-term, comprehensive commitment; it amounts to a cultural change for the company. Construction is no simple deterministic system. Lean principles must be understood and applied in a context and require a comprehensive understanding of a complex, interacting and uncertain construction system. Many lean principles can be understood as attempts to increase prepl anning ability, improve organizational design and increase flexibility.

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1. INTRODUCTION

a. Brief History of Lean and its introduction in project management:

The concept of lean is not new but infect it has a very long history. Normally in literature, it is found that the root of Lean derive from manufacturing industry i.e. Toyota production , Ford and the production line of ford for the Model T ford. Basically the roots of Lean manufacturing and Just in Time (JIT) Production bring us to Eli Whitney and the concept of interchangeable parts. Eli Whitney used this concept for the manufacturing of Muskets in the late 18 century.

Fredrick Taylor's work on scientific management investigated workplace efficiencies with the approach of scientific management. The concept of Taylor by applying science to management was effective but at that stage Taylor did not consider the human psyche and behavior sciences and its influence. Consequently Lillian Gilbreth brought physiological factor and work on motion studies. The basic aim of his studies was to count for the motivations of workers and how their attitude affect the output of a process. These people have infect originated the idea of "eliminating waste", a key principle of Lean Manufacturing.

Henry Ford Start with the concept of Lean production in 1910. Henry Ford and Charles E. Sorensen, was the first person who established and documented the strategy for production based on Lean Manufacturing concept. He has categorize all the key elements of a manufacturing system including Manpower, Machines/equipments, Tools and arranged them in a systematic manner for manufacturing the Model T Ford automobile. After that Ford became one of the richest person because of his great achievements in manufacturing industry and tried to put the whole world on wheels. Consequently Ford's methods used for mass production and were highly effective during world war-II where Ford helped to build Bombers at the Ford Willow Run plant and Boeing. That is why Ford is considered by many people and literature to be the first practitioner of Lean Manufacturing.

By the end of World War-II, The American government help Japanese to stand again the industry on their own foots. Consequently US sent advisors and consultants including Edwards Deming, and Joseph Juran, to provide aid and advice for manufacturing industry development. The Japanese industrialist studied the concept of American tool techniques for production and give special focus to Ford manufacturing processes along with Ishikawa and some other great researchers. Shewhart, Deming, Juran, and some consultants that were sent to help TOYOTA and other Japanese companies and to realize the importance of quality in manufacturing industry. Eiji Toyoda & Taiichi Ohno visited Ford for understanding the Ford production concepts. At Toyota Motor Company, Taichii Ohno and Shigeo Shingo, incorporated Ford production and other techniques into an approach called Toyota Production System or The basic objective of project management is to successfully complete a project within the budget, time line, quality and scope. For this all the resource including manpower, machinery, and materials is to be affectively used so that the required objectives are achieved. The concept of lean is one of the most successful idea especially in the manufacturing industry and projects.

According to Mr. Leach Lean project management convince to change the behavior from multi-tasking on several project to a single project at a time. Lean project management is very affective by avoiding the delays in production mainly taking into account the manpower to be effectively used and play rule in the completion single task/project. Primarily lean project management focusing on running organization which are based on continuous improvement over the period of time systematically achieve small incremental improvement in process by eliminating wastes.

b. Importance of Lean concept in organizations

The concept of lean is mostly followed in manufacturing industry for continuous improvement and elimination of waste in processes through kaizen which is small and incremental improvement over a period of time. Single piece flow is focused for operation and working on one product is done at a time to avoid excessive inventory, produce high

quality, less space to be occupied, avoid over allocation of resources and increase the manufacturing process flexibility.

Both construction and manufacturing industry of Pakistan is suffering right from inception. Our government is always give priority to conventional manufacturing & construction processes and resist to change for improvement in processes. Currently no any single Pakistani based major industry is implementing the concept of lean with proper documentation and analysis for improvement over period of time.

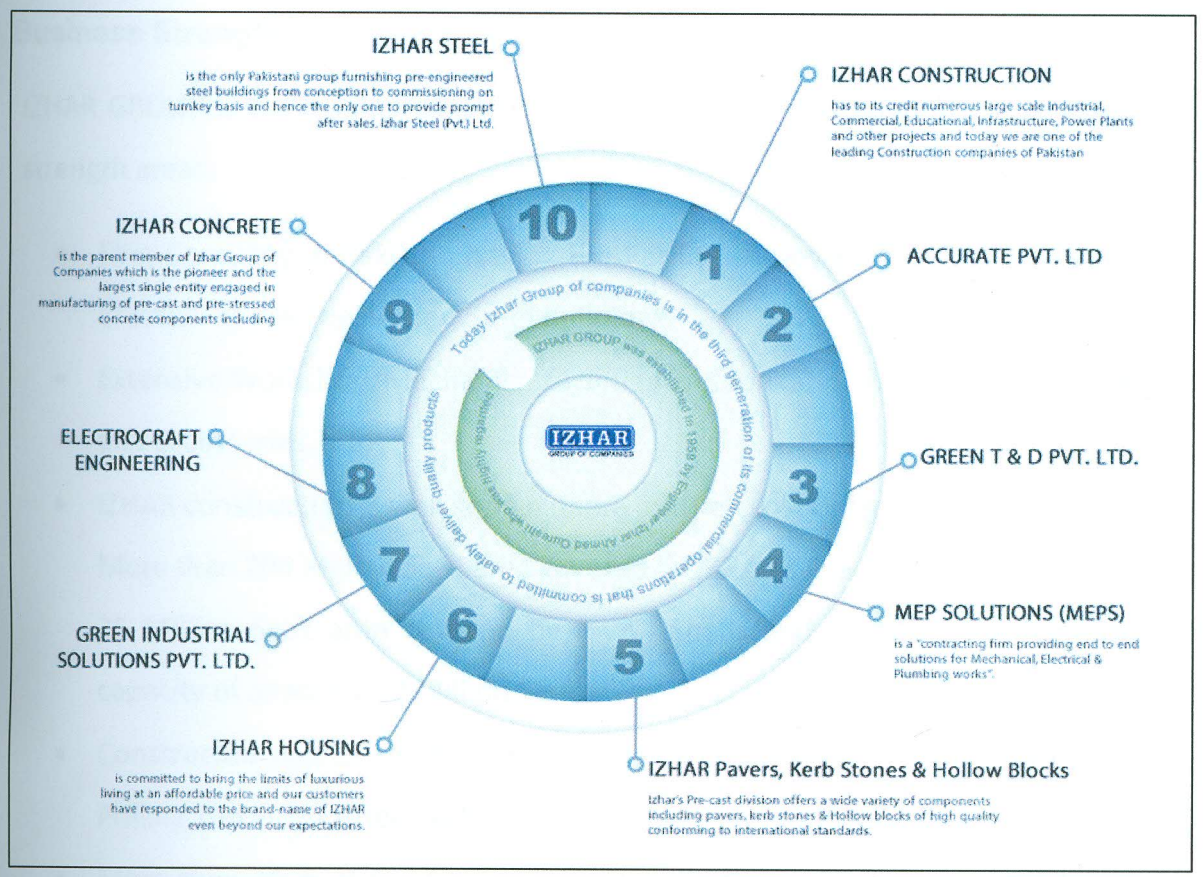
Over the world, the applications of lean is not only limited to manufacturing industry but also used in the research, IT and construction industry. Some of the major benefits of lean project management are as follow:

- Effective engagement and utilization of Resources
- Behavior change over period of time
- Elimination of wastes
- Quality production and fewer defects
- Avoid over production
- Effective communication
- Effective utilization of space available
- No excess inventory
- Responsive to change
- Customer focused
- Stronger research and process effectiveness evaluation

2. IZHAR GROUP OF COMPANIES

a. Introduction

IZHAR GROUP was established in 1959 by Engineer Izhar Ahmad Qureshi who was highly regarded amongst the veteran engineer's community of Pakistan. Form the humble beginning at Burewala, Izhar Construction (Pvt.) Ltd is flagship steering of IZHAR GROUP OF COMPANIES, engaged in business activities in all corners of Pakistan. The Group is contracting mainly in engineering and construction projects and has vast experience in infrastructures, industrial, commercial, educational, and other development projects along with Precast and Pre-stressed Concrete Solutions in Pakistan.



b. Vision/Mission

To achieve Client's satisfaction by providing, Task Specific, Time Efficient and Cost Effective, Design Services and Engineering Solutions. The remarkable success of this group over the couple of years, highly professional team comprising of diversified experience over these year strengthen the vision of becoming the leading construction group of Pakistan. The group deal in all type of development project including Electro mechanical services. The policies of this group prioritize to strong commitments toward customer satisfactions in all products and all services comprising the name of IZHAR GROUP and giving high attention to stringent Quality codes in nourishing the business strategies on all well-defined ethical lines. The mission of IZHAR GROUP is to be a determined leading construction group of Pakistan and to leave no stone unturned in the efforts and struggles of continuously improving our services day by day.

c. Business Strength

IZHAR GROUP is the leading construction company of Pakistan with the following key strength areas;

- First Company in Pakistan having the Facility of Design, Fabrication, Supply and Erection of Pre Engineered Steel Buildings.
- Extensive Workshop/Mechanical facilities for fabrication of high quality form work and accessories.
- IZHAR construction is well known name for Pre-cast concrete products in Pakistan. More than 200 Million Sq.ft area covered by IZHAR's Pre-Cast Products, More than 25 Million Sq.ft area covered by R.C.C. Shells and the Per month production capacity of almost 1.10 Million Sq.ft.
- Constructed one of the tallest concrete structures in Pakistan. 105 meter high Prilling Tower for three Fertilizer Plants.
- More than 20 % of the total Textile Units in Pakistan are either constructed by IZHAR or covered by the IZHAR's Pre cast roofing system.

- IZHAR Group has also worked on very sensitive projects like the Development of Shahbaz Existing Air Base Jacobabad Package Tac- 01 & Tac-03. The project comprising of more than fifty Buildings/ Structures including Offices, Technical Buildings, Maintenance Hanger, Storage Structures etc. The Scope includes Civil, Electrical, Plumbing, HVAC, Fire Fighting & Fire Separation, Fire Alarm, Communication, Security System etc. The project cost exceeds Rs. 3.70 Billion.
- IZHAR Group has successfully completed some mega projects in Pakistan. e.g. Construction DHA Haly Tower, Telecom Tower is 30 Story, Construction and Fit-Out of Fortress Stadium Mall including Hypermarket, Silver Oaks Luxury Apartments at F/10, Islamabad, 6700 TPD Cement Plant for M/s D.G.K. Cement Company Ltd., PAPER SACK PLANT for Nishat Shuaiba Paper Product Company, Honda Car Plant.

d. Marketing areas

Following are the major areas of marketing of IZHAR Group;

a) Pre-Cast Concrete Products
b) EPC Projects
c) Pre-Engineered Steel Buildings
d) Mechanical Fabrication and Erection of Plants
e) Solution and Services of Electro Mechanical and Plumbing (MEP) Works

3. INTRODUCTION OF LEAN IZHAR CONSTRUCTION (PVT.) LTD.

a. Proposal for Lean Concept Implementation

I. Applications of Lean Construction

With the continuous increase in competition in construction industry, the construction business tend toward decline in profits margins as no significant tools and techniques for process improvement are used in construction like manufacturing industry. Now a days most of the contractors and leading construction companies working with primary objective to eliminate wastes and increase the profitability of the business. Applications of lean concept in construction is almost same as in manufacturing industry except from some minor differences. Following are the key applications of Lean concept which can contribute in the improvement of construction process of Izhar Construction (Pvt.) Ltd once implemented.

- Elimination of wastes in construction processes and materials e.g. Concrete, Steel, time, Cost, and idle manpower and Machinery
- Process improvement in Construction Planning, Execution, Monitoring, communication etc. in a systematic manner
- Definition of clear set of objectives and milestones
- Production of better quality concrete, MEP and Finishing works
- Developing a lean culture in the organization which continuously improve itself
- Involve client and other stake holders closed in the project
- Logical distribution of Manpower with clear set of role and responsibilities

b. How to Implement Lean in Construction Industry

Since 1990's the international community of researcher trying to apply the Lean production principle in construction industry. The international group for Lean Construction (IGLC) significantly contributed to the formulation of Lean concept in construction while applying and analyzing the relationship of the basic principle of lean

to the construction management processes. Paez et al. (2005) introduce that the nature of planning, execution and operation are the major areas which differentiate the construction industry from manufacturing industry one or another way. The traditional construction process always believe on optimistic approach and pushing more tasks will bring better results.

Koskela et al. (2002, p.211) define the Lean construction as "Lean construction is a way to design production systems to minimize waste of materials, time, and effort in order to generate the maximum possible amount of value."

II. Major differences b/w Construction and Manufacturing Industry

S.no	Property	Manufacturing Industry	Construction Industry
1	Life Cycle	Usually Short	Long Duration
2	Nature of work	Unique	Operation
3	Work Station	Variable	Stabilized
4	Environmental Factors	Highly Influencing	Less Influencing
5	Technology use	Less automated	Automated & Advance
6	Sponsor/Client	Highly Involved	Less involved directly
7	Culture	Site environment	Industry Environment
8	Regulatory Intervention	Each design and work tends to approval process	Less subject to checks and approval
9	Safety	Less enforced	Highly Enforced
10	Manpower	Temporary	Permanent
11	Quality	Rework is high	Rework is less

III. Framework for Implementation

Social-Technical system for Lean construction

This system combine the Human psyche and technological system into a single work structue. According to Paez et al, Lean implementation in construction and Lean implementation in manufacturing industry are the same social-technical structure with similar objectives but with different technical systems. The human system will be always problem focus, believe in team working and creative thinking.

Technical subsystem	Property	Construction Project	Manufacturing Process
	Just-in-time	Material kanban cards Last Planner	Kanban system Minimum batches
	Smooth Production	Concurrent Engineering Daily huddle meeting	Production Levels Multi-functional layout Standardize operations Preventive actions
	Autonomation	Quality management Visual inspection	Total Quality Management Autonomous control
Source: Paez et al. (2005)			

IV. Tools for Lean implementation in construction

The following tools can be used to implement the concept of lean in construction and evaluate the performance based on the results from the implementation of the tools.

1. Last Planner
2. Increased Visualization
3. Daily Huddle Meetings
4. First run Studies
5. 5s Process
6. Fail Safe for Quality and Safety

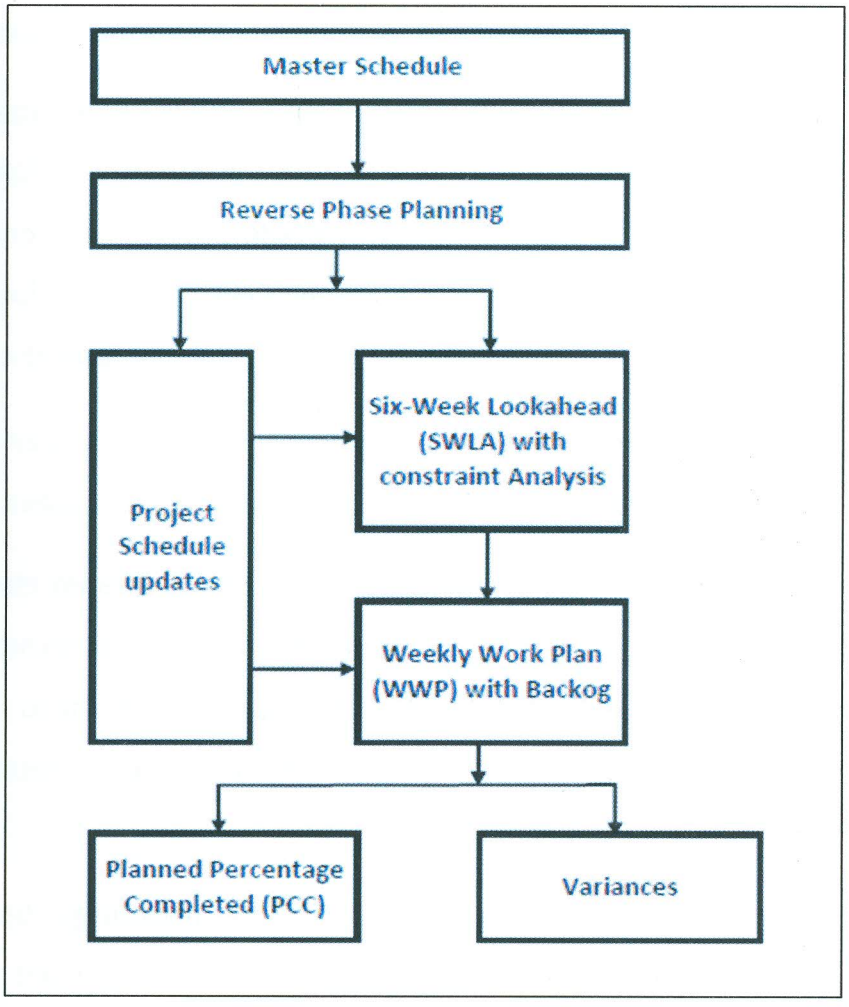
I. Last Planner system

Last planner system is a short term planning system in construction used to enhance work flow, team working and established behavior changes toward work in an organization. The last planner system make each individual and team to be accountable for their milestones while significantly improving the project safety, accelerating time of delivery, increase productivity, problem focusing, increasing profits and benefiting the staff working on the projects. The Last planner system make sure management of project in a collaborative manner, address the issue at early stages to be resolved before they become critical at later stages, enhancing the flow of work to be streamline and increasing the chance of timely completion of milestones of the project. This system will improve the following areas of construction project of Izhar group.

- ✓ Increase safety, faster delivery and reduction of cost
- ✓ Problem focus and resolution at early stages
- ✓ Team working and reduce stress on project team
- ✓ Improve the overall construction management
- ✓ Application of Just-in-Time concept to satisfy customer

The last planner system is a systematic approach toward project management which replace the Traditional push system of scheduling technique with pull system of scheduling. It shall be implemented in the below sequence.

a) Master Schedule
b) Reverse Phase Scheduling
c) Six-week look ahead and Constraints analysis
d) Weekly Work Plan
e) Percent Plan Complete & Variance Analysis



The last planner tool replace optimistic planning of traditional critical path method with more realistic planning by evaluating the performance of workers based on their ability to reliable achieve their commitments.

Master Schedule

Master schedule is the schedule generated at initial stage to cover the complete scope of works, timelines for each activity along with milestones to be delivered at different stages.

In order to implement lean construction in Izhar Construction (Pvt.) Ltd. the Project manager and Planning Engineer will generate master schedule for all phases using experience form similar nature projects, organizational process assets and enterprise

environmental factors. The master schedule and Issue for Construction (IFC) drawings will be communicated to all last planner and suppliers before the Reverse Phase scheduling.

Reverse Phase Scheduling (RPS)

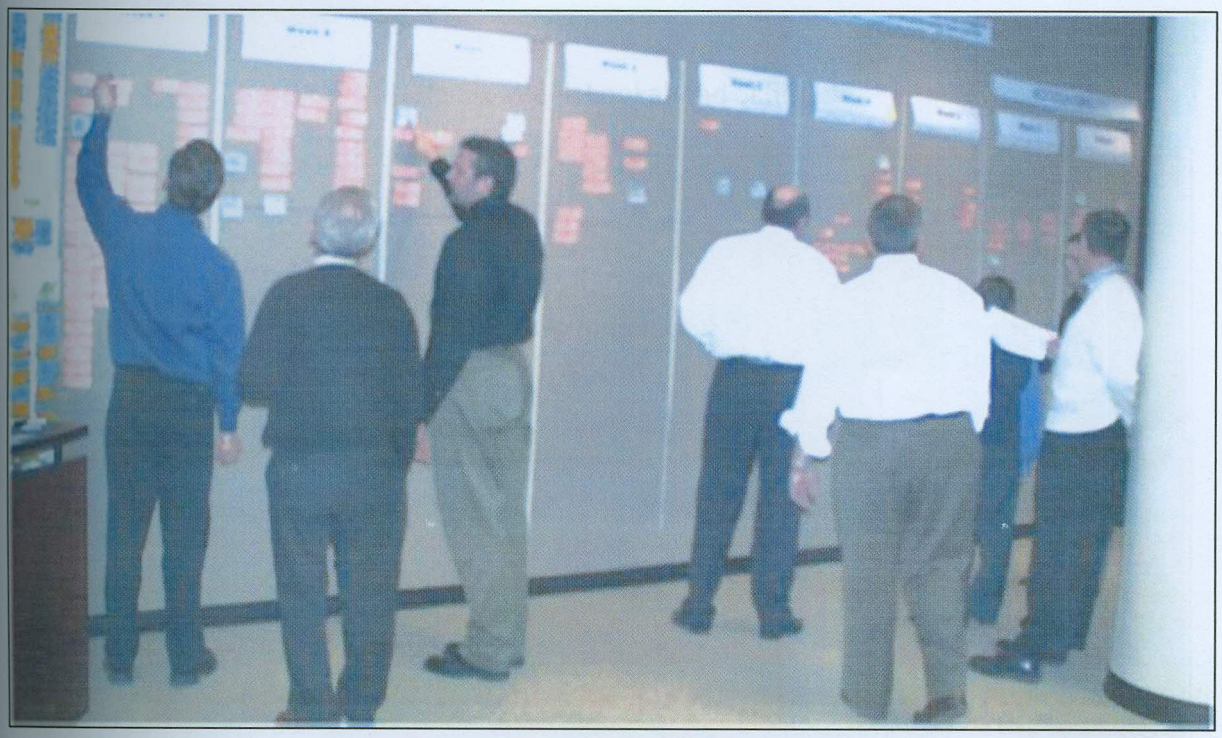
In the reverse phase scheduling the phases are broken down from Master schedule and the team responsible for the phase jointly generate a plan for the phase. The last planners use pull system of scheduling and begins from the end of the phase (Customer) and pull works to find that,

- Identifying activities/works to deliver the phase as per customer requirements
- Input, resources, tool & technique to perform the activities/ works

The pulling gets rehashed until the whole phase is divided to form a network work packages for the completion of the phase. This system is called reverse phase scheduling or pull system of scheduling for projects. This is quite close to reality than the master schedule because the work is broken down by the expert of related with progressive elaboration.

In the proposed organization (Izhar Group) prior to the meeting for pull scheduling for work, proper training will be given to the team for understanding purposes of all requirements Lean construction, last planner methodology to all the last planner and team members. After that meeting will be conducted reverse phase scheduling and subsequently all the last planner, construction team and material suppliers will write activities for the milestone completion and the activities will post it along with timelines on long sheet or board/wall showing the completion dates from reverse sequence for the phase. Logical relationship in activities will be find and the sequence of post it will be made on the wall and all the post it will be arrange in the same sequence. Critical activities and path shall be identified and contingencies reserve shall be determined for those activities with uncertainties. The whole process will be recorded with complete documentation.

Reverse Phase Planning by project planners

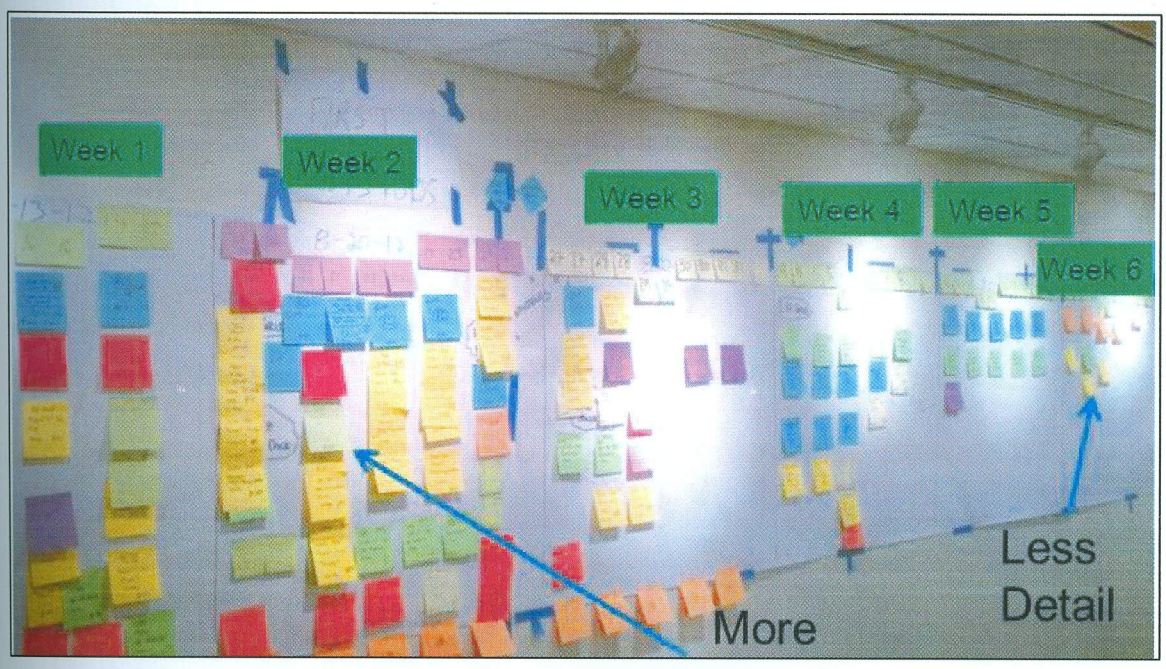


Six-Week Look ahead (SWLA)

Six-week look ahead is another tool used in lean construction. Six-week look ahead schedule is used for the future work required to be done and to see the work to be done after six week. The time six week is taken because of the fact that most of the construction activities done without facing any major problem, if it's indicated before six weeks. The six-week look ahead schedule make sure that all the works in predecessor has to finish before the work which has to be started after six week. The basic purpose of creating this schedule is to minimize the uncertainties in future and get streamline flow of works.

For the Izhar Construction, I'll propose that the Six week look ahead schedule will be generated by project manager and construction manager on the basis of results of Reverse Phase Scheduling. Post it shall be made for different works and should be pasted on the board after six-week. Detailed constraints analysis shall be done by both the managers and constraints shall be indicated. Once the Six-week look ahead schedule is generated, it shall be provided to all last planner for implementation and to avoid future uncertainties.

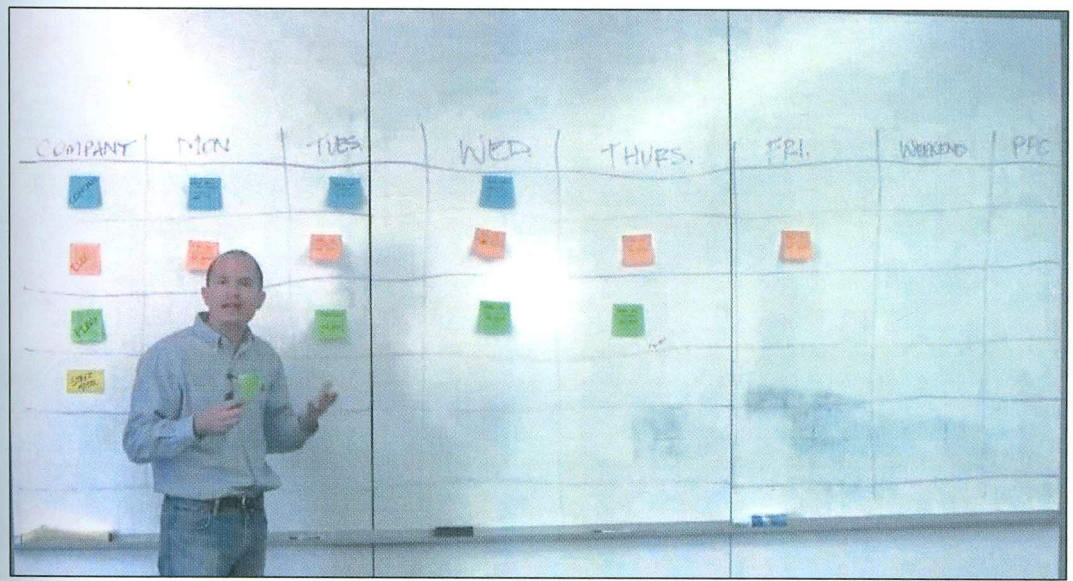
Sample Six-Week Lookahead Schedule



Weekly Work Plan (WWP)

The WWP is generated on the basis of SWLA plan, the current site condition before the weekly meeting and actual status of the schedule at current stage. The weekly work plan is more detailed and activities are planned for each day. The weekly work plan meeting cover more details e.g. weekly manpower, schedule activities, safety and quality issues, status of construction material at site, procurement under progress, status of equipment, construction mythologies, backlog of ready works, communication barriers and the constraints present at site at current in the current week. The biggest advantage of weekly meeting is to support two-way communication and to share the necessary information in an efficient way. Different variance analysis can be done for the previous work plan all the causes shall be documented to be incorporated in the next weekly work plan schedules.

For the lean concept to be implemented in Izhar Construction, I'll propose that all the last planner along with project manager and construction manager will attend the meeting on each Monday. All the last planner will submit the work plan for the upcoming week to the project manager prior to the weekly meeting. It will cover the complete scope on daily basis activaties. The meeting will be open for two-way free communication to share all the information and problem arising at the project site as well as with external stakeholders.

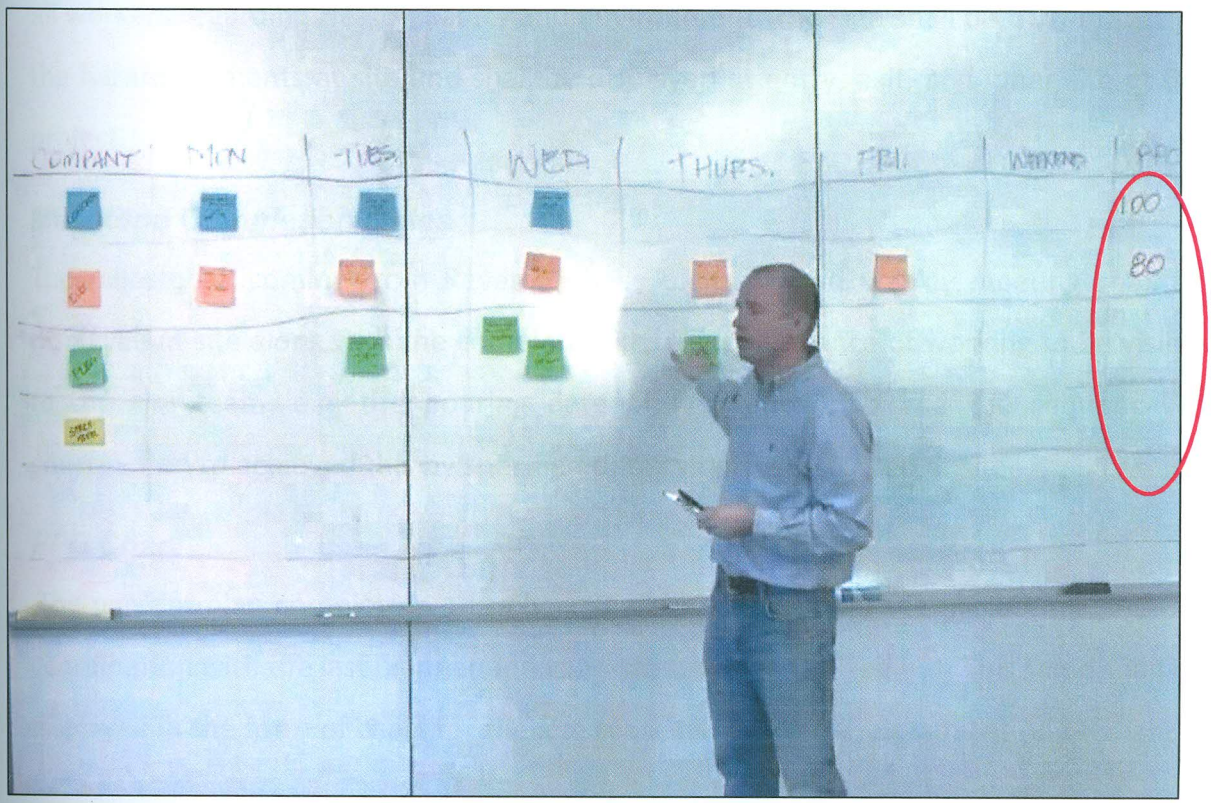


Percent Plan Complete (PPC) and Variance Analysis

Percent plan complete is the technique used for measuring the performance of last planner numerically. The PPC is determined by simple mathematical calculations while dividing the actual performed work by planned work. As per Ballard (1999) guidelines these values lies in the range of 30% - 70% generally for construction work without the implementation of Lean construction concept. By the implementation of lean concept the values greater than 70% has achieved.

As per my proposal for Izhar construction the progress officer will determined PPC for each last planner by crossing the planned activities (post it) on the board of respective activites which are completed up to the current period. Variance analysis shall be made and the cause and effect will be discussed with project and construction manager. Some forecast shall also be made based on PPC values.

Percent plan completed



II. Increased Visualization

The increased visualization is an important tool used to effectively communicate important information through sign boards and pictures displayed at construction site visible to the team working on site. By posting key information at site, all the team member including worker can easily work to be done, performance, targets remaining and specific action which can increase the work flow at site. The most common signs are regarding Health, Safety, environment, quality, activities schedule etc.

In this proposal to M/S Izhar Construction, the following sign shall be used to increase the performance at construction site.

Safety Sign

The safety sign board shall be installed at construction which is visible to labor as well as site visitor and the professional team at all the time. The project manager will involve the workers ideas to increase their involvement in safety and training shall be given to all workers regarding Health, Safety and environment. The sign shall be truly reflecting the hazard elements at site and shall be displayed at entry, exit, and inner site of the project.

Milestone Completion Dates

The milestones coming from Reverse phase planning and weekly meeting shall be displayed at site along with the completion date and sequence of working to be visible to the site team. e.g. the pouring date of first floor slab and the sequence of construction to achieved this by specified dates shall be displayed at site.

PPC Chart

The percent plan complete works chart shall be analyzed by the project manager in coordination with the last planner and variances shall be worked out. This same shall be displayed in the form of chart for the site team to visualize their current performance,

difference with planed work and realize the site team to decide their strategy for the remaining work to complete the work within the specified cost

III. Daily Huddle Meetings

The daily huddle meeting is an informal two-way open communication meeting which increase the employ involvement and interaction with each other to resolve the issues at site and share information. This meeting increases awareness, problem solving approach of all the team members, Training and instruction for the team members and increase the satisfaction & motivation level of the employee.

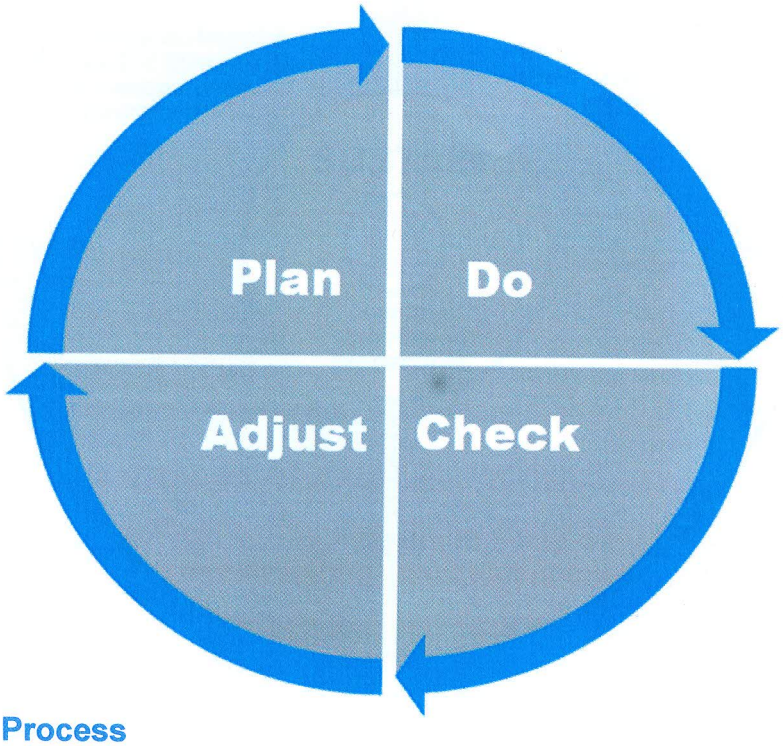
For the Izhar construction this informal meeting will be conducted for 10-15 Minutes in the morning prior to start of the work and will led by the construction manager. Professional staff & site workers will attend this meeting to quickly discuss the status of what they had been taking a shot at since the last day meeting particularly if there is any problem which obstructing the work flow.

IV. First Run Studies

First run studies used for continuously improvement in the process by redesigning the important activities and function involved. This is also called Deming cycle because it was introduced by Edward Deming in Japan in 1950. The basis of First run studies is to Plan-do-check-adjust (PDCA) cycle. The is an improvement cycle based on scientific principle of proposing some changes to be done, Implementing these proposed changes, measuring the result after the implementation of change and adjust the change as need.

For Izhar construction the first run studies shall be done by the research team, Quality & Design team and detailed analysis shall be done taking in account the elimination of wastes, quality, safety, cost optimization etc. Plan shall be made based on the result of analysis will be presented to the project manager for further actions. If the project manager allow for implementation then it shall be implemented at some other parts

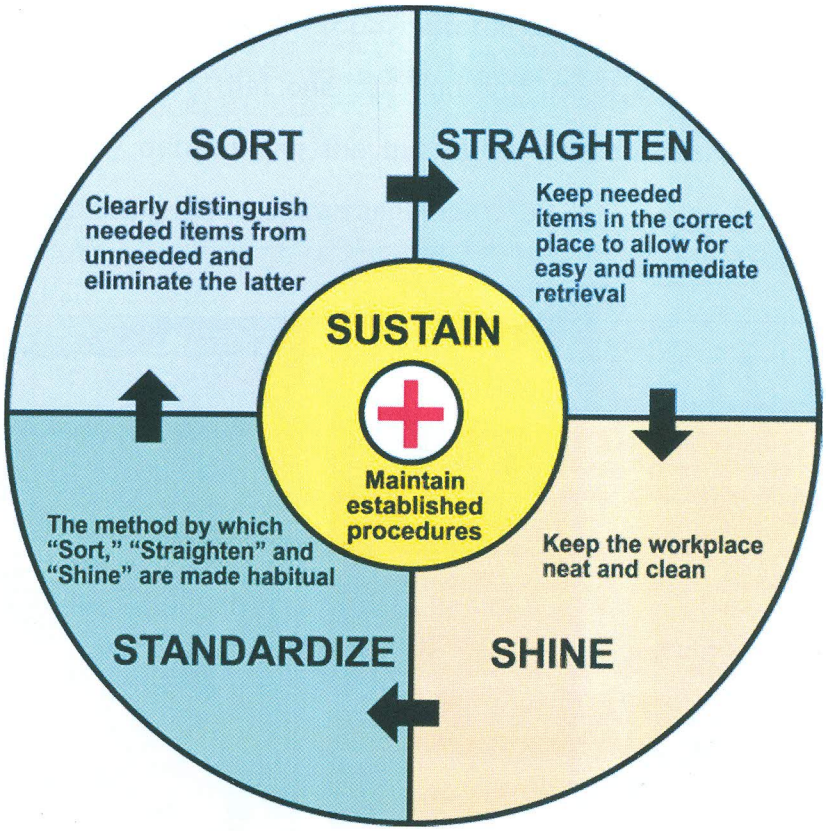
of the project for the improvement of construction processes. If the results are desired then this process shall be used for onward works and the organizational process assets shall be update accordingly.



V. The 5s Process

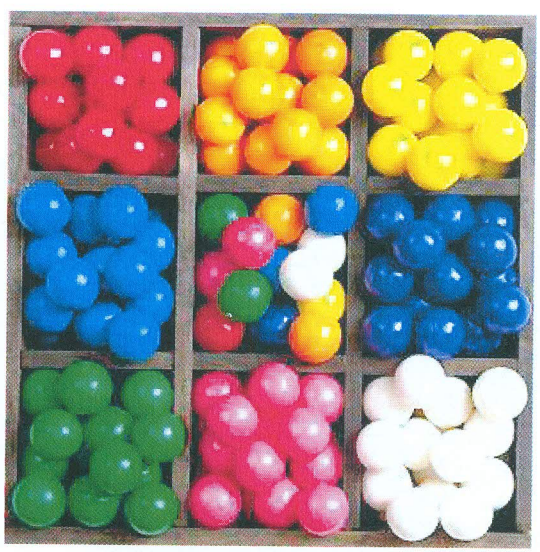
This process is the most famous process followed in manufacturing industry under lean applications because this process is most effective in case of stabilized work station "a place for everything and everything in its place". This process contain 5 processes of housekeeping and is very effective to eliminate the waste of resources. The implementation of 5s bring improvement in the work safety, high production rate, create free work space, high quality of product, reduce lead time, reduction in cyclic duration, proper arrangement of materials and machines etc.

- Seiri (sort)
- Seiton (set in order)
- Seiso (shine)
- Seiketsu (standardize)
- Shitsuke (sustain)



Seiri (sort)

This process refer to sort out and separate all needed tools from/materials and remove the unneeded tool to eliminate the wastes.



Seiton (set in order)

Set in order mean that all the tools/material shall be placed in a proper well defined order arrangement so that one can find and use it easily we needed. This shall be implemented by determining the quantities of materials/tools, identifying suitable location and placing it in order arrangement.

Seiso (Shine)

Shine means that keep the construction site in good condition and clean to make sure Health, Safety, environment and proper working condition. This is one of the important housekeeping to be done at site.

Seiketsu (Standardize)

This process refer to state/environment to properly maintain the first 3s (Sort, set in order and shine) at site.

Shitsuke (Sustain)

This process turning all the good practices into work habits. This can be done by training employee, separate team for 5s implementation, resource for implementation and support the 5s from managers and higher management.

VI. Fail Safe for Quality and Safety

Fail safe for quality is the lean concept technique which eliminate all the defectives part to flow in the process and introduce ideas which can be use as alert for potential defects.

In this proposal quality assurance and quality control team will select all those activities that has defect in quality for further studies in order to prevent the activities from such issues. Fail safe for quality will be used as complete risk assessment tool for quality and safety at the construction site. This process will be different from the traditional inspection of some parts but the focus will be potential hazards instead of potential defects.

V. Technology required for the support of this application

There is no any complex/special technology or software need for lean concept implementation in M/S Izhar Construction (Pvt.) Ltd projects. In fact the technology used today in construction industry is sufficient for Lean implementation, but the convention practices needs to be advance as per the framework of Lean concept implementation to eliminate wastes and improve the processes continuously.

VI. Area of Business to cover

The following business area shall be covered in IZHAR Group with the implementation of Lean concept;

- Design, Construction
- Procurement
- Planning/Control
- Supply
- Installation
- Collaboration
- Behavior
- Management

Izhar Steel

Izhar steel construction is mainly composed of Mechanical Fabrication & Erection and Pre-Engineered Steel Buildings. The introduction of pre-fabricated steel buildings and mechanical fabrication has further revolutionized the industrial construction and cemented the supremacy of being the largest multidimensional engineering entity of Pakistan. Since the steel construction is new area of business in construction industry in Pakistan and the competitors increasing day by day. Secondly the steel fabrication and erection is very similar in nature to manufacturing industry. This area is best suited to be implemented the concept of Lean construction and continuously improve the fabrication and erection processes.

Izhar Concrete Construction

Currently Izhar Group is dealing in both Pre-cast concrete product and construction projects in Pakistan. The Pre-cast concrete product is somehow similar in nature as of manufacturing industry, however the construction projects need to be implemented with different concept know is Lean construction. Numerous approaches are developed globally in construction industry to enhance the efficiency and effectiveness by

elimination of all those activities and processes which did not add any value. Lean try to eliminate or minimize the wastes and continuously improve the construction process. The key business area of Izhar Construction include but not limited to Effective communication and team coordination, Team working, Visibility of Milestones, Last Planner approach in construction, Increase in quality and safety, etc. are best suited to be implemented with lean concept because highly qualified and professional staff is running the industry.

VII. Major Benefits

Following are the some major benefits of lean implementation in construction projects;

- Construction processes improvement
- Waste elimination/minimizing
- Effective communication
- Customer focus
- Less inventory
- Behavioral Changes
- Increase visualization
- Team working and encourage employ involvement
- Solution of constraints on daily basis
- Increase in quality of products
- Timely completion of Milestones
- Safety insurance
- Cost effectiveness by eliminating NVA
- Effective monitoring and progress tracking

VIII. Team to develop this application

The team to develop this application includes but not limited to the following;

- Research team
- Project Manager

- Construction Manager
- Planners
- Suppliers
- Project Team

IX. Major Risks in Implementation

- ❖ Resistance by the Project Manager, suppliers & project team to adopt change and follow the procedure and guidelines of Lean construction.
- ❖ Training shall not be provided at the appropriate time
- ❖ The Master Schedule is not developed appropriate to lean implementation.
- ❖ The Reverse phase scheduling is one of the most important milestone of last planner technique. If the RPS is not up to the mark then the objective of Lean implementation will not be meet.
- ❖ Behavioral changes of project team from traditional method to lean concept is one of the major risk involved in the implementation
- ❖ The PRS and WWP meetings do not hold on right time
- ❖ The constraint shall be properly analyzed

X. Major Milestones

- Master Schedule will be developed to cover the complete scope of work
- Reverse Phase Schedule (RPS) shall be generated with the coordination of project Manager, Construction Manager, Last Planners and suppliers
- SWLA & constraint analysis
- WWP & Backlog
- First run studies (FRS)
- Fail Safe for Quality & Safety
- Progress updates and planned percentage completed
- Variance analysis
- Implementation and OPA updates

II. Major Stakeholders

- Project Sponsor/Client
- Design Team
- Project Manager
- Construction Team
- Planners
- Suppliers
- Government Departments

III. Staff Strength and their Designations

No extra staff is required for the implementation of lean concept at project level. The staff is almost same as for traditional project management except some time planners, researchers and analysist to evaluate the effectiveness of the application and analyze it.

4. Conclusions and Recommendations

This report mainly focus on implementation of Lean construction tool in the construction industry because the tool is already implemented in manufacturing and software industry and has successfully achieved the objectives of lean concept. Since the dynamics of construction industry is significantly different then the manufacturing industry and therefore some modification is done in the implementation and tools of lean concept. The commitment from the top management plays an important role in the implementation of this concept. The lean concept don't any extra ordinary arrangement in the construction industry but it mainly emphasize on the behavioral shift from traditional procedure to advance procedure which continuously focus on processes improvement and eliminating not value added elements. It is recorded from history and practical experience that at the beginning of the implementation of this tool everyone at site will resist to adopt the change, but once it implemented then everyone feel comfortable and found himself motivated with this tool.

From the study and review of several previous researches, it was found that the concept of Lean in construction industry is as much effective as in manufacturing industry. Last Planner, 5s, daily huddle meetings and increased visualization has achieved the highest result in many case studies after implementation lean in construction industry. The FRS and FSFQ were slightly less effective in the improvement of process and will be implemented with some modification. The overall performance of this tool is very effective than the traditional approaches used in construction.

It is recommended that this tool shall be implemented in organizations accepting to improve the construction process with certain degree of risk involved in the implementation. Furthermore the organization will comprised of committed leadership, highly motivated team and expert of Lean tool. The team shall be properly trained prior to the implementation on actual site. Variance analysis shall be done the organization process shall be updated.

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