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Lean construction practice: culture, standardization and informatization —— A case from china

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Part One : Introduction

- Many construction enterprises in the world are practicing lean construction and benefiting from it.
- The concepts and ideas of lean construction have been introduced into China, however, **the practice is still fragmented and Lean construction in a Chinese context has not been well studied.**
- **The aim of this study** therefore is to introduce a Chinese construction company and its lean project implementation, demonstrating some the most successful lean construction outcomes in China.
- The case company is a pioneer of lean construction practitioner in China, and its Jiuzhou Garden residential project No.58 building are studied as one of the most successful lean construction cases in China.

Part Two：Methodology and methods

●**A case study approach is used** in this paper, as lean concept may be new to most of Chinese building professionals.

●The authors of this paper had tracked the whole project , collected data from interviews, meetings and statistics.

Case background

✓No.58 building comprises 30-story frame shear wall structured housing including one below-grade floor, with a total area of 21,000 square meters.

✓Lean methods and tools such as 5S on-site management, LPS, Work structuring, Value management, Visual management and Takt planning are used.

Contrast sample group

➢In contrast six same size buildings were used as a sample group.

➢None of those above mentioned lean tools are applied in the contrast sample group.

➢The case study project and the contrast sample buildings makeup of the whole residential project of 142,000 square meters.

Part Three : Collaboration model

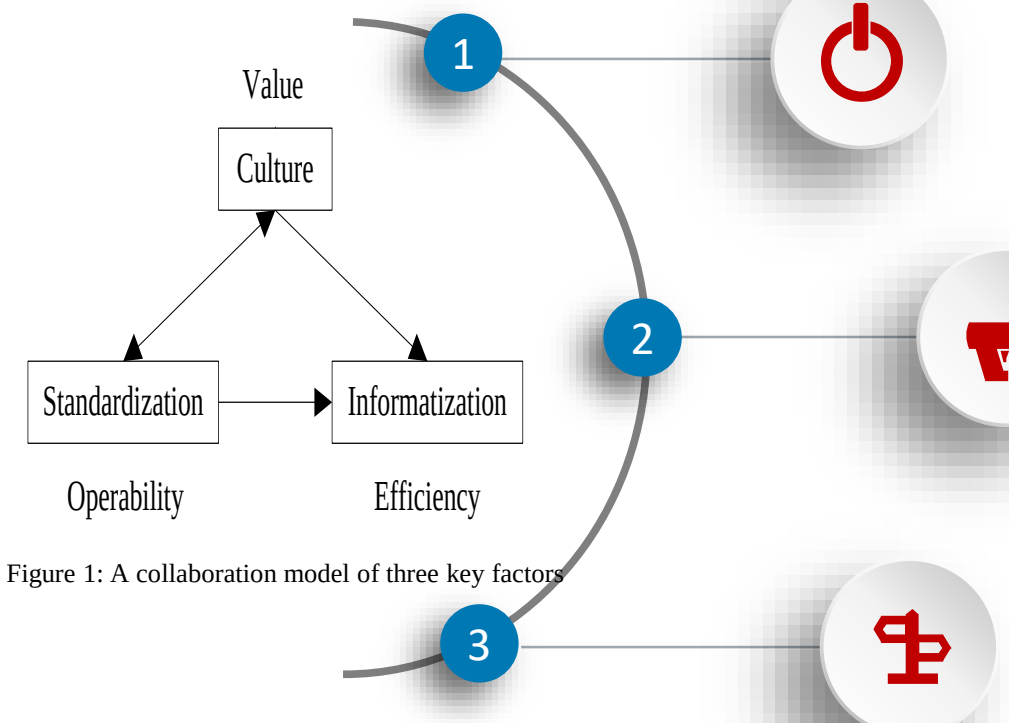


Figure 1: A collaboration model of three key factors

Hypothesis 1

Culture has positive effects on Standardization and provides incentives for employees.

Hypothesis 2

Standardization fills the gap between lean culture and the operability, also forms the foundation of informatization.

Hypothesis 3

Culture has positive effects on informatization by promoting employee skills upgrading to improve efficiency.

●Three key success factors are summed up in the case project and the company, a collaboration model developed.

Part Four：Three key factors——Culture

Double core value culture

Customer value culture with zero quality defects

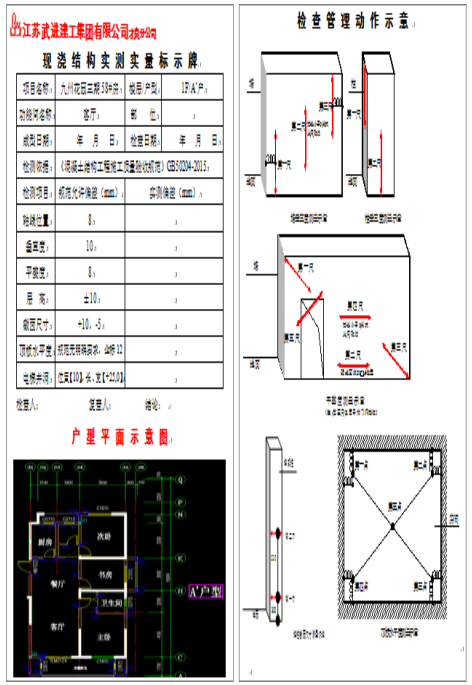
- Craftsman spirits and a high-quality housing as core value.
- Putting customer value first and setting up zero quality defect goal.
- The company has won a high reputation to satisfy consumers with zero quality complaints.

Employee value culture with cultivating people

- Create clean and safe project work environments
- Enhance the professional dignity
- Strengthen the professional quality of managers and operation workers
- Pass on and mould craftsman's spirit in construction industry

Part Four：Three key factors——Standardization

Standardization



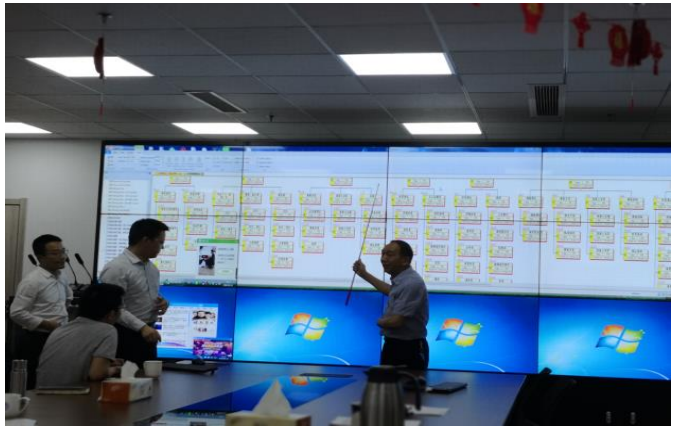
Six parts consist of the standardization

1. Construction drawings standardization
2. Standardization of engineering technology
3. Network plan standardization
4. Quality management standardization
5. Construction operation standardization
6. Safety management standardization

Part Four：Three key factors——Standardization

Standardization

●Standardization works as a process optimal method of Work structuring, basing on a deepening WBS to optimize both process and value.



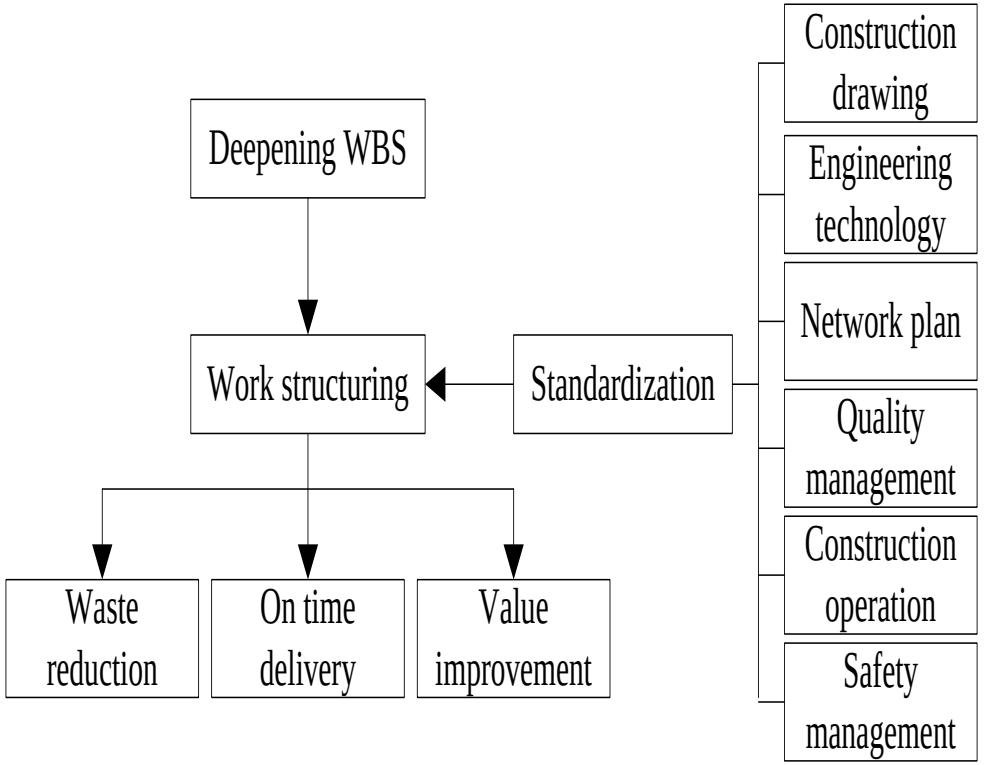
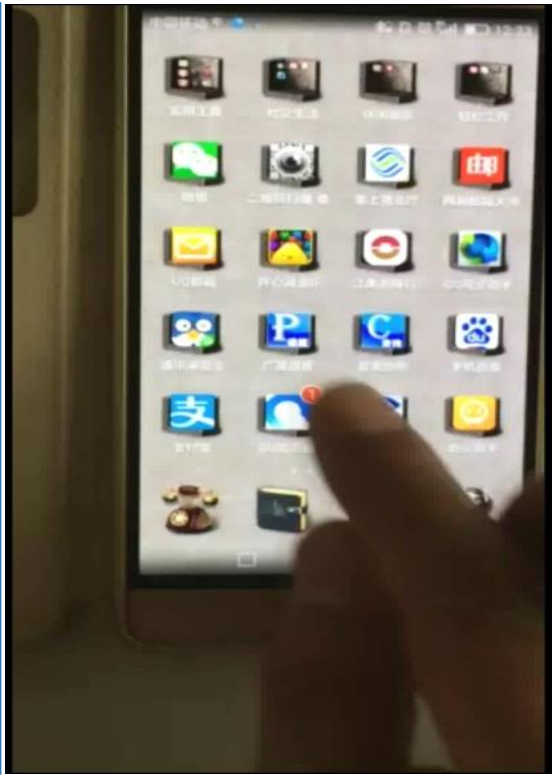


Figure 2: The framework of WBS, Work structuring and standardization

Part Four：Three key factors——Informatization

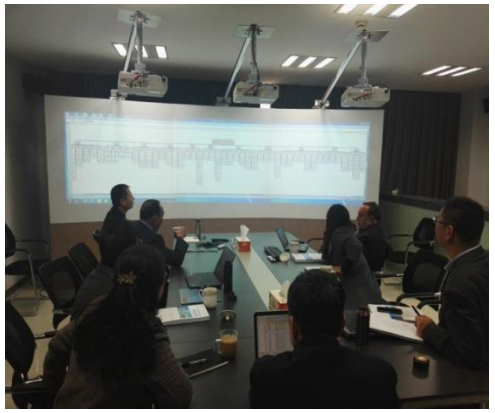
Informatization



- An hour level precision control on LPS implementation
  - ➢Precision control on an hour level
  - ➢The pull mechanism of look-ahead planning
  - ➢Commitment planning

Part Four：Three key factors——Informatization

Informatization



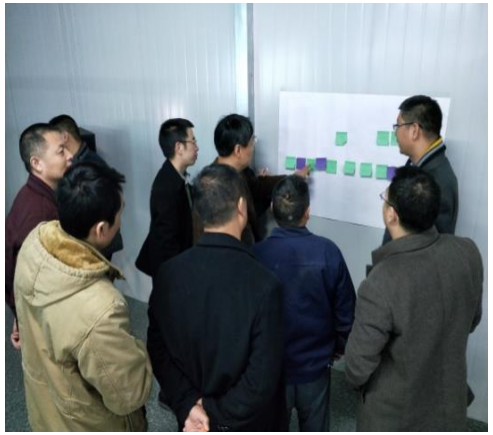


Table 1: An hour level control of scheduling

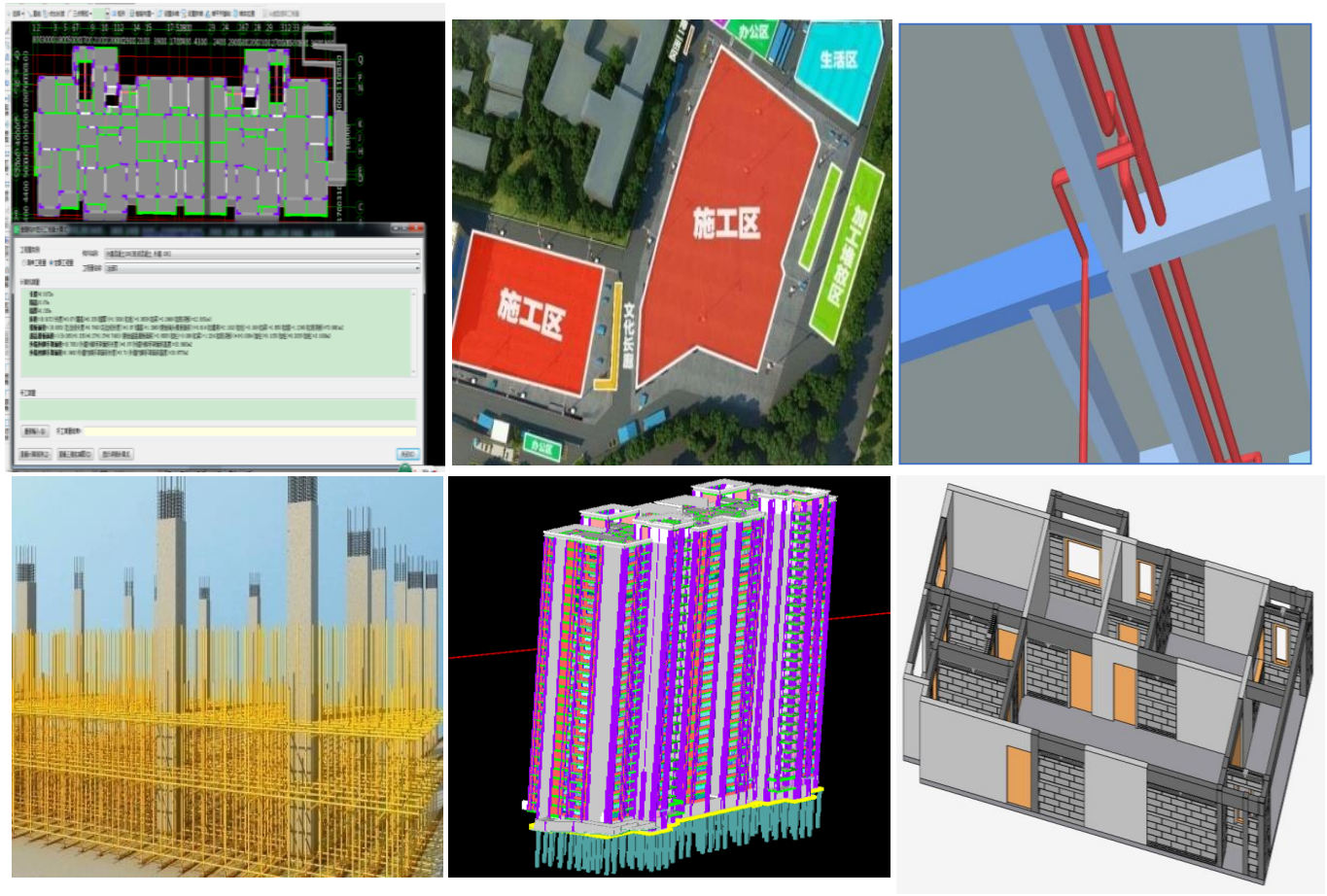
Project Procedures	Working hours	Team	Examiner	Operation standards	Acceptance criteria	Detection method	Monitoring frequency	Safety precautions	supervision or coordination	Rules for Calculating Quantity	Other standards attachment	Remarks	Examination
Preparation	1.50	Project department	Primary structure inspection group	See details	See details	See details	Check before concrete pouring	See details	Builder, Security officer, Crane driver et.al		Link	6.1 Formwork inspection batch acceptance record	1
Ash damper cleaning wet and hanging	0.50	Concrete team	Primary structure inspection group	See details	See details	See details	Patrolling		Security officer, Quality staff	See details	Link	Photos uploading and records retention	4
Formwork clear and watering	0.50	Concrete team	Primary structure inspection group	See details	See details	See details	Patrolling		Builders, Quality staff	See details	Link	Photos uploading and records retention	1
Mortar back to pump	1.30	Concrete team	Primary structure inspection group	See details	See details	See details	Patrolling		Builder, Security officer, Crane driver et.al	See details	Link	Photos uploading and records retention	1
Concrete pouring and vibration	10.00	Concrete team	Primary structure inspection group	See details	See details	See details	Patrolling	See details	Builder, Security officer, Crane driver et.al	See details	Link	Photos uploading and records retention	1
Mold observation	10.00	Woodworking team	Primary structure inspection group							Calculated by floor area			1
Reinforcement observation	10.00	Reinforcement team	Primary structure inspection group							Calculated by floor area			1
Water and electricity observation	9.70	Hydropower installation team	Primary structure inspection group							Calculated by floor area		Photos uploading and records retention	1
Recycling of ground ash	8.70	Concrete team	Primary structure inspection group	See details	See details	See details	Patrolling		Builder, Security officer, Crane driver et.al	See details	Link	Photos uploading and records retention	1
Ash damper cleaning and recycling	10.20	Concrete team	Primary structure inspection group	See details	See details	See details	Patrolling		Builder, Security officer, Crane driver et.al	See details	Link	Photos uploading and records retention	1

Part Four：Three key factors——Informatization

Informatization

- *BIM application*

➢BIM application in this case study contributes mainly in visual communication and supplementary optimization such as modeling and amounting, field layout, measure model, construction model, deviation adjustment and process model etc.



Part Five：Hypotheses Validity

●Hypothesis 1 and 2 validity

•**Culture effectiveness is reached rather by providing incentives and operability**.

•**Zero quality defect goal was achieved by strict operation standards and every stage of standardization**, thus to fill the gap between culture and operability.

●Most on-site workers expressed “we are willing to work under such tough standards if we are told clearly enough, because less rework and few repairs will happen, and we are paid promptly”.

●Hypothesis 3 validity

•Informatization is proved to improve efficiency not only by transparent and convenient communication **but by facilitating employees’ skills upgrading**.

•Most of the workers indicated that they “are pleased to cooperate in data acquisition and testing of operating standards and to use information tools” and appreciated “**both increased wages and decent work”**.

•The site manager also declared that “once workers are used to using task assignments APP and inquiring on craft methods database, **management works will be reduced while safety and quality being better guaranteed”.**

Part Six：Discussion and Conclusion

Table 2: Performance comparison between No.58 building and traditional samples

Compared item	Contrast samples	No.58	Improvement rate
Duration	530 day	426 day	19.62%（-）
Skilled labour	369	310	16.00%（-）
Labour cost	6,390,300（RMB）	6,241,600（RMB）	2.33%（-）
Total cost	26,437,960（RMB）	25,675,957（RMB）	2.88%（-）
Quality	/	Zero quality defect	/
Safety	/	Zero safety accident	/

- **LPS practice** supported by an hour level precision control contributes to **duration saving**.
- Standardization taken as Work structuring tools **results in quality and safety improvement**.
- There presents more **orderly and cleaner construction site and energetic workers** in the case project in contrast to the contrast sample group.

Part Six：Discussion and Conclusion

- The case study provides some new insights that how lean construction implementation can be adopted in Chinese construction industry.
- **People are incentive to accept lean concepts and provided with convenience to take actions**.
- Standardization, as an exploration of Work structuring, is tried to connect TFV theory with traditional tool of WBS to guide operations.
- Informatization makes it possible to realize LPS implementation on an hour level precise control.
- **The effective leadership** of the company plays the key role of success. The advocator and leader as a **soul figure** together with a **high executive team** has created company-wide cultural transformation and lean implementation.
- Further studies are needed to investigate other more companies and projects to experiment the model validity.
- Moreover, the findings are limited to the contractor practice of lean construction, with few effects to the design stage.
- Future research will focus on transferring lean ideas from contractors to designers, subcontractors and suppliers to promote the change of the whole industry chain.

Acknowledgment

●We would like to thank **Cailiang construction technology Co., Ltd and the project team** for the cooperation and providing access to data collection and investigation.

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Thanks for your attention!