Lean Construction

Improving Stakeholder Value while Reducing Waste

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Flow of Talk

History of Toyota

Toyota Production System / Lean Thinking

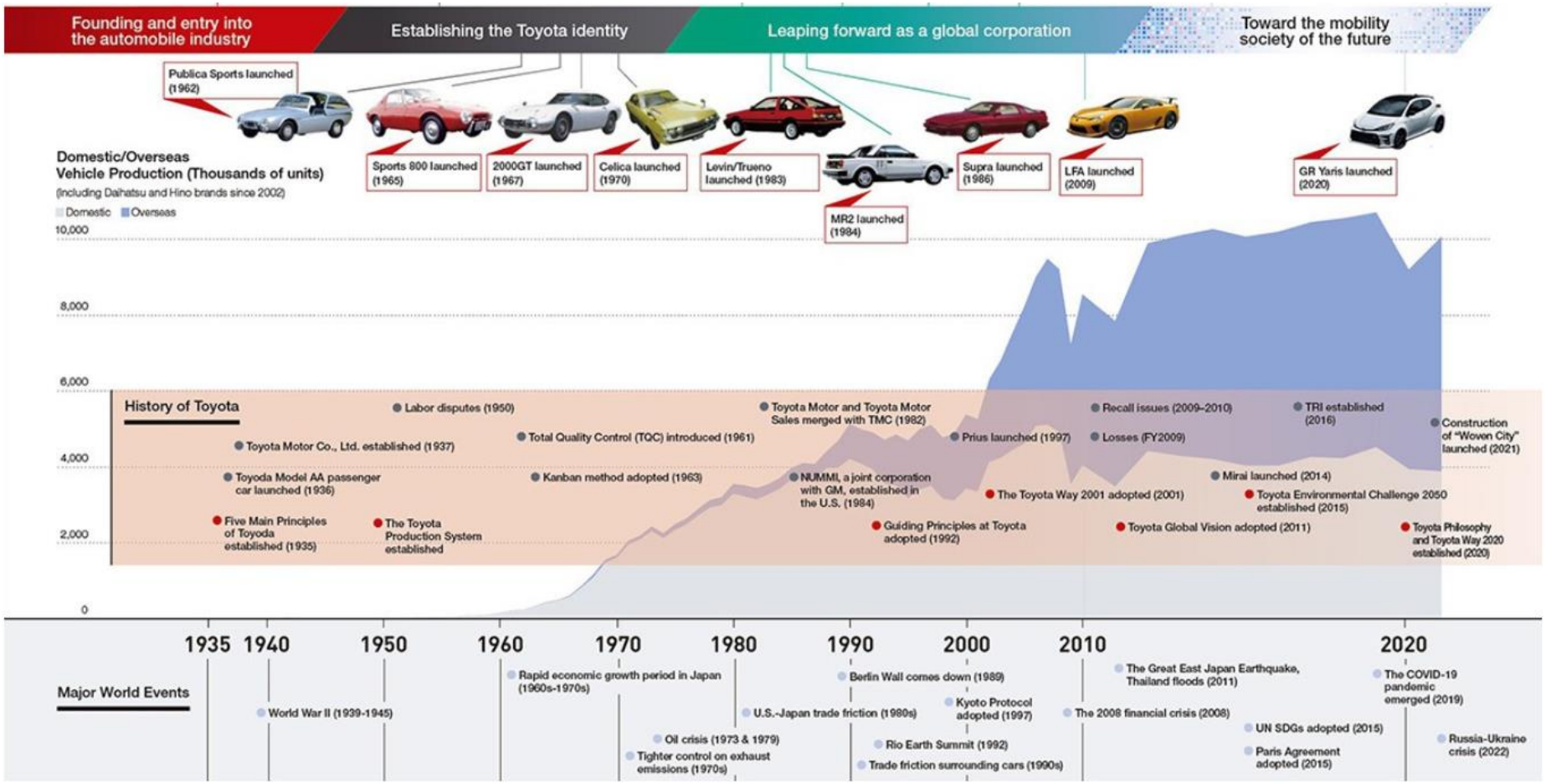
Waste (muda) and Kaizen

Lean Construction

Application of lean in construction

Summary and Ideas for research

History of Toyota



Short history Toyota

- Ikichi Toyoda – rice farmer, poor carpenter + small plot of land
- Sakichi Toyoda (son of Ikichi born 14 April 1867, just before Meiji Restoration opening up of Japan
- Toyoda Automatic Loom Works founded by Sakiichi Toyoda
- Sakichi – became national hero, entrepreneur, inventor – invented the Weaving Machine that has automatic stop when thread snaps (1926)
- Invented many looms, including automatic weaving loom that stopped itself (Jidoka)

Short history Toyota

- 1937 Toyota Automotive Co., Ltd founded by Kiichiro Toyoda - adaptation of Ford system to small production volume
- 1947 – Supply truck for government

- **1950 – Financial crisis, restructure, layoff , labor dispute**
- 1953/54 - Trucks production increased 3000/mth without increasing workers
- 1955 – Kanban started in machining factory first – then body assembling, stamping, casting plant, right up to suppliers, heat treatment
- 1960 – Jidoka introduced – line stop system

  at that time physical line stop – no

  advanced sensors (Ohno san said –

  worker gets fatigue he should stop the line

- Provides Basis for Toyota Production System

Short history Toyota

Toyota Production System founded by Taiichi Ohno (1940s-70s)

1965 Deming Prize Quality Award

1973 Oil Shock: Japan in Recession and TPS first gets widespread attention.

1990: The Machine that Changed the World: "lean production" (Womack, Jones and Roos,1990)

1996: Lean Thinking- Banish Waste and Create Wealth in Your Corporation (Womack and Jones , 1996)

2000 Liker J., Toyota Way

2012 – Toyota – No 1 World Automobile Manufacturer

- http://www.toyota-global.com/company/history_of_toyota/75years/
- Visit this site for more info

Five Main Principles Toyota

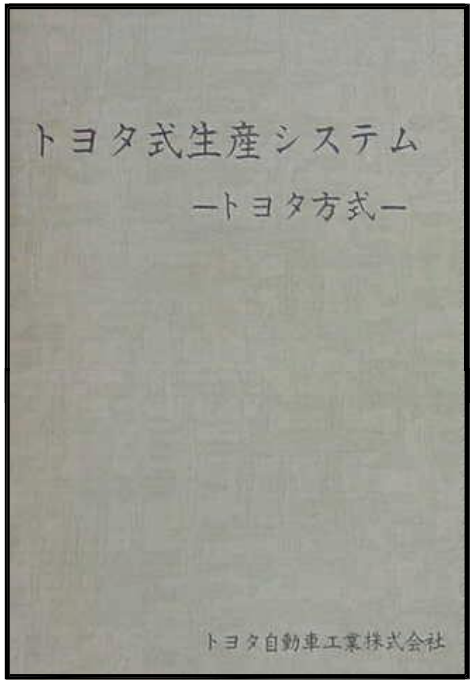
Sakichi Toyoda

1. Always be faithful to your duties, thereby contributing to the company and to the overall good.
2. Always be **studious and creative**, striving to stay ahead of the times.
3. Always be **practical and avoid frivolousness.**
4. Always strive to build a **homelike atmosphere** at work that is warm and friendly.
5. Always have respect for spiritual matters, and remember to be grateful at all times.

Statements and teachings of Sakichi Toyoda which was collected and arranged by Risaburo Toyoda and Kiichiro Toyoda released 30th October 1935 on fifth anniversary of Sakichi's death


Bloomberg

TPS Summary 1973



First TPS Manual. 1973 Education & Training Department

論 よ り 実 践

"Practice over theory"

専務取締役

Managing Director

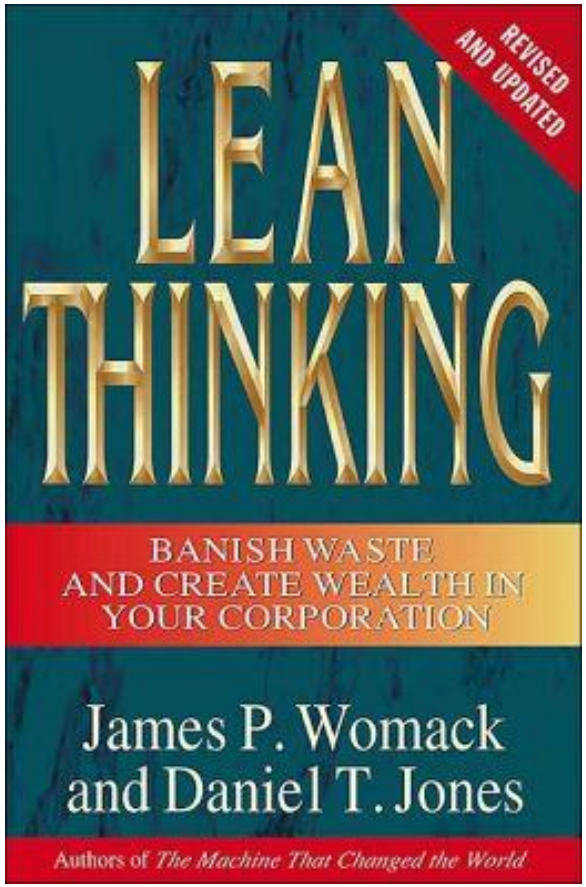
大野耐一

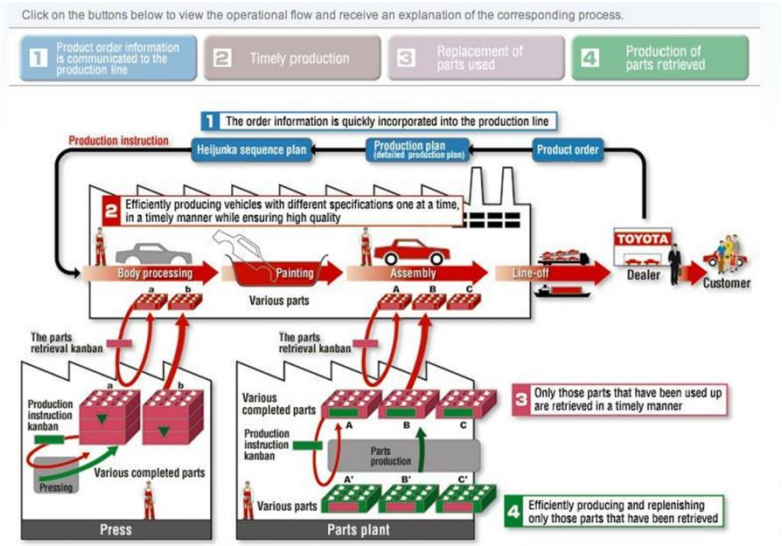
Ohno Taiichi

1. TPS is a series of related activities aimed at **elimination of waste** in order to **reduce cost, improve quality, and improve productivity.**
2. Scientific Mindset: On the shop floor it is important to start with **actual phenomenon (gembutsu)**and search for the root cause in order to solve the problem. In other words we must **emphasize getting the facts**..
3. In **problem solving** the purpose must be made clear, and in **Kaizen** the needs must be made clear.

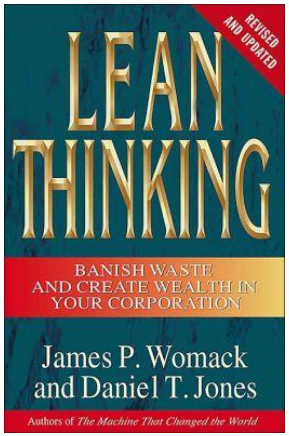
Lean Thinking

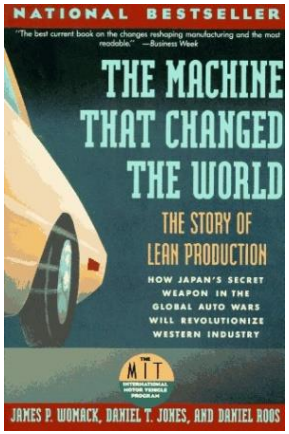
- Lean Thinking antidote to **muda** (waste) after research on TPS
- Provides a way to do more and more with less and less
- Less human effort, less equipment, less space and closer to providing customers with exactly what they want
- Provides a way to make work more satisfying to convert waste or **muda** into value

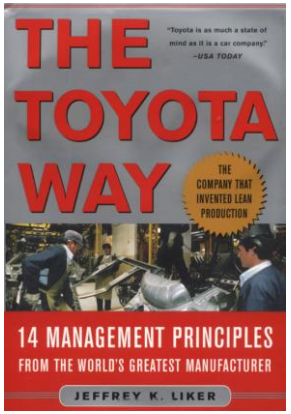


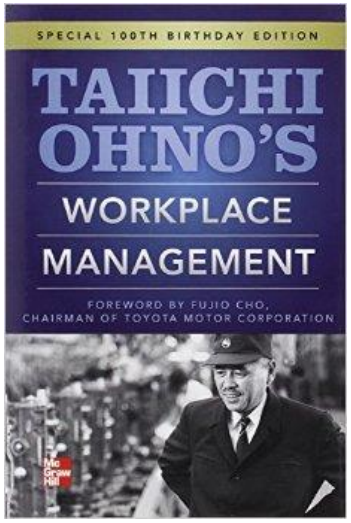


1937 -2021 - 84 yrs









Lean Thinking Principles

Lean Principles

1 Specifying Value

Value can only be defined by the ultimate customer

"Value is only meaningful when expressed in terms of a specific product or service which meets the customer needs at a specific price at a specific time"

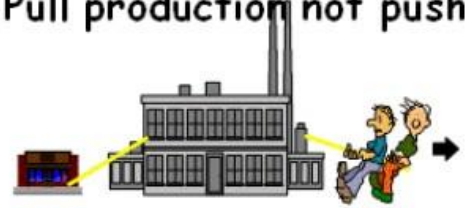
2 Identify and create value streams

"A value stream is all the actions currently required to bring a product from raw materials into the arms of the customer"

3 Making value flow

"Products should flow through a lean organisation at the rate that the customer needs them, without being caught up in inventory or delayed"

4 Pull production not push



"Only make as required. Pull the value according to the customer's demand"

5 Striving for perfection

Perfection does not just mean quality. It means producing exactly what the customer wants, exactly when the customer requires it, at a fair price and with minimum waste.

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RESPECT FOR PEOPLE		CONTINUOUS IMPROVEMENT		
Respect	**Teamwork**	**Challenge**	**Kaizen**	**Genchi Genbutsu**
• Respect others • Make every effort to understand each other • Take responsibility • Do our best to build mutual trust	• Stimulate personal and professional growth • Share opportunities for development • Maximize team and individual performance	Long term vision to meet challenges with courage and creativity to realize our dreams	Improve business operations all the time by always trying for innovation and evolution	Go to the source to find the facts to make correct decisions and build consensus and trust

Continuous Improvement pillar

Challenge

Long-term vision, meeting challenges with courage and creativity to realize our dreams

- Creating value through manufacturing and Delivery of Products and Services
- Spirit of Challenge
- Long-range perspective
- Thorough Consideration in Decision Making

Kaizen

Improve our business operations continuously, always driving for innovation and evolutic

- Kaizen Mind and Innovative Thinking
- Building Lean Systems and Structure
- Promoting Organizational Learning

Genchi Genbutsu (Go to the Genba)

We practice Genchi Genbutsu….. go to the source to find facts to make correct decisions, consensus and achieve goals at our best speed

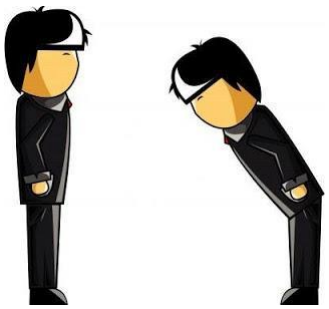
- Genchi Genbutsu
- Effective Consensus Building
- Commitment to Achievement

Respect for People

Respect

We **respect others**, make every effort to **understand each other,** take responsibility and do our best to build mutual trust

- Respect for Stakeholders
- Mutual Trust and Mutual Responsibility
- Sincere communication



Teamwork

We stimulate personal and professional growth, share the opportunities of development and **maximize individual and team performance**

- Commitment to Education and Development
- Respect for the Individual; Realizing Consolidated Power as a Team


"First we build people, then we build cars."
~ Fujio Cho, Former Chairman Toyota Motor Corporation

3Mu concept

MUDA = waste

MURA = unevenness/unbalanced

MURI = overburden (stress)

MURA?

Inconsistency. Unevenness.
Caused by irregular production schedule or fluctuating production volumes. Leads to MUDA.

MURI?

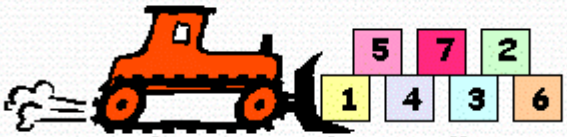
Overburden.
Achieved when man or machine is pushed beyond natural limits. This can be due to MURA.
It leads to safety and quality problems.

Waste (Muda)

- Lean focus on waste removal inside and outside the company
- Value stream – supply chain = customers+ suppliers' network
- Must learn how to find waste and problems in the system
- Must systematically attack waste underlying poor quality, poor processes and fundamental management problems.

The 7 Wastes

MUDA is the Japanese word for WASTE.



Seek it out and get rid!

Overproduction

To produce sooner, faster or in greater quantities than customer demand.

An 8th waste is the wasted potential of people

Over Processing

Processing beyond the standard required by the customer.

Inventory

Raw material, work in progress or finished goods which is not having value added to it.

Rework

Non right first time. Repetition or correction of a process.

Waiting

People or parts that wait for a work cycle to be completed.

Transportation

Unnecessary movement of people or parts between processes.

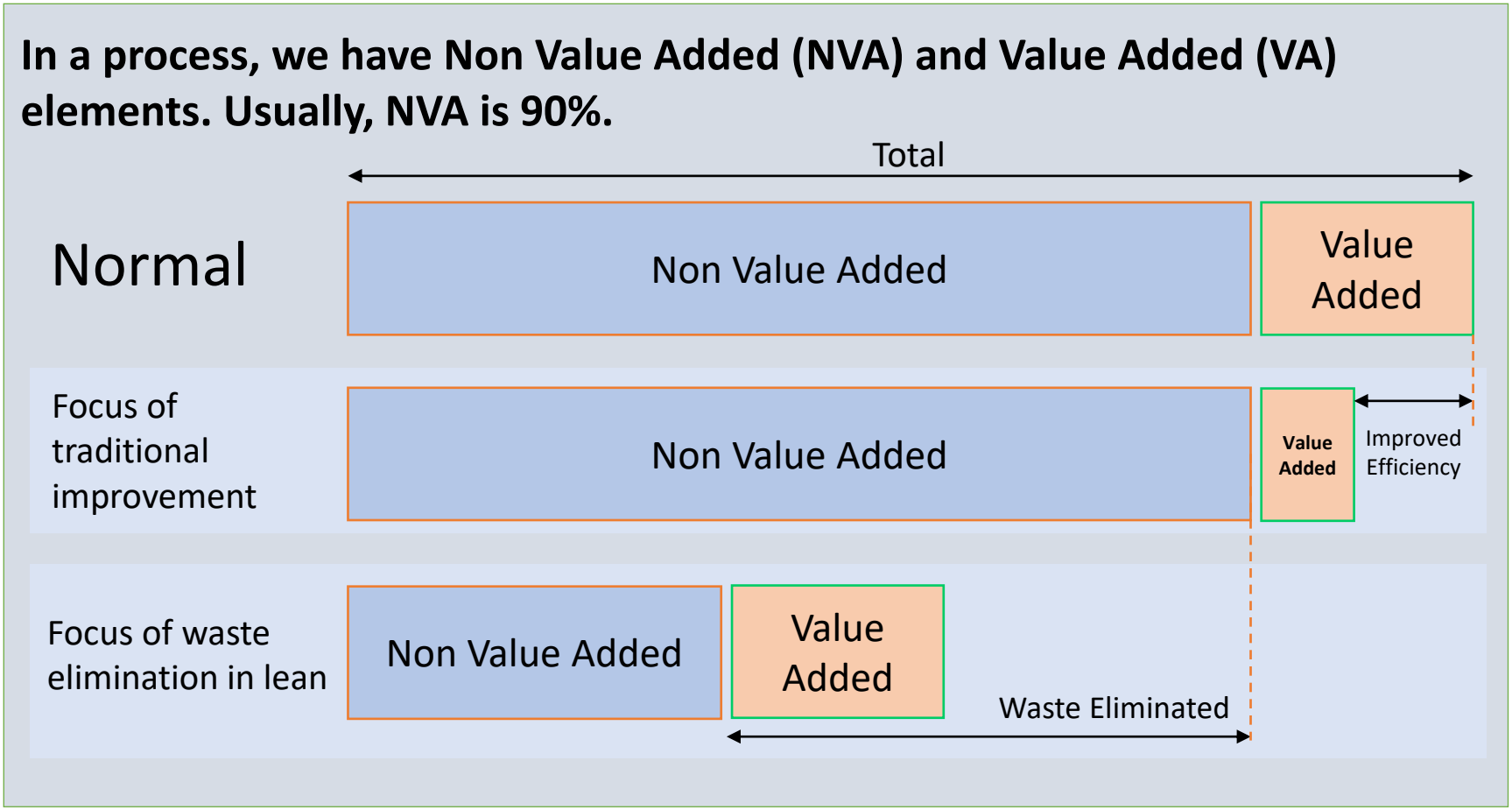
Motion

Unnecessary movement of people, parts or machines within a process.

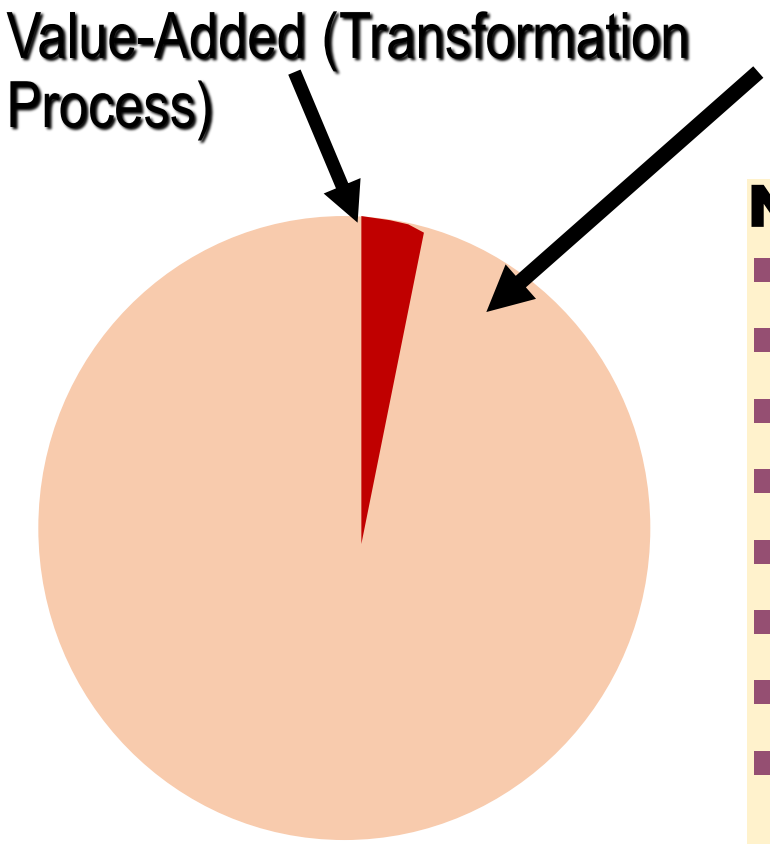
What is Waste?

Anything in the process/activities that **does not add value.**

In a process, we have Non Value Added (NVA) and Value Added (VA) elements. Usually, NVA is 90%.



Lean = Eliminating Wastes

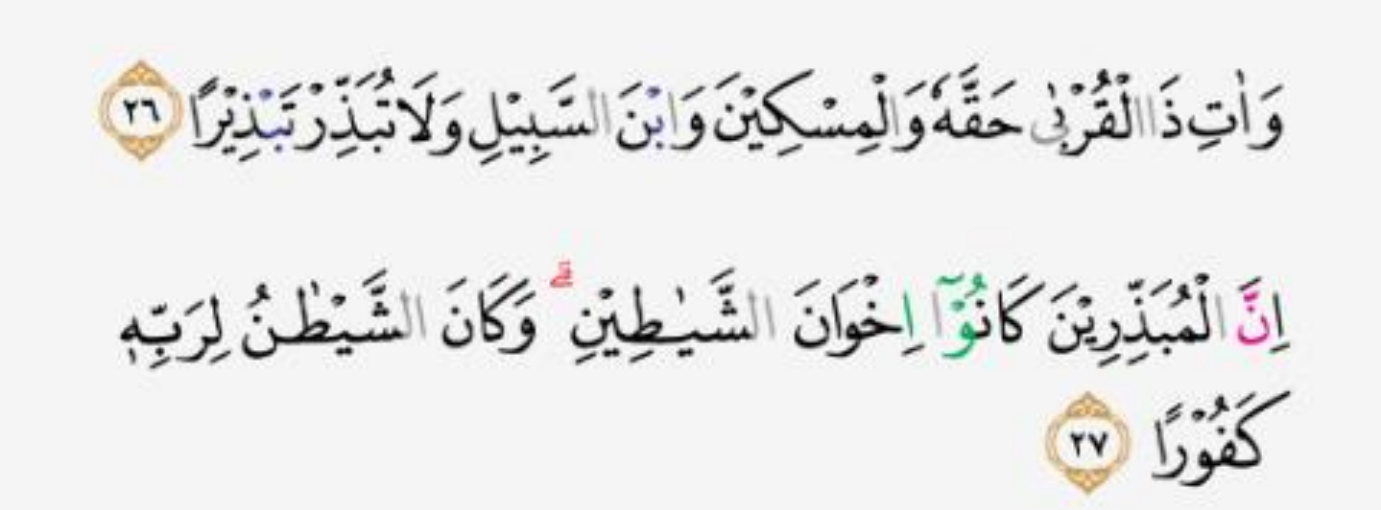


Non-Value-Added

- **D**efects
- **O**verproduction
- **W**aiting
- **T**ransportation
- **I**nventory
- **M**otion
- **O**verprocessing
- **Unutilized** Talent/Employees (K,S,A)

Typically 95% of all lead time is non-value-added

Waste according to Islam


وَاٰتِ ذَا الْقُرْبٰى حَقَّهٗ وَالْمِسْكِيْنَ وَابْنَ السَّبِيْلِ وَلَا تُبَذِّرْ تَبْذِيْرًا ﴿٢٦﴾

اِنَّ الْمُبَذِّرِيْنَ كَانُوْٓا اِخْوَانَ الشَّيٰطِيْنِ ۭ وَكَانَ الشَّيْطٰنُ لِرَبِّهٖ كَفُوْرًا ﴿٢٧﴾

And give the relative his right, and [also] the poor and the traveler, and do not spend wastefully (Israk:26)

Indeed, the wasteful are brothers of the devils, and ever has Satan been to his Lord ungrateful (Israk:27)

Waste according to Islam

Ablution - Wuduk (washing before prayers)

- 'Abdullah ibn 'Umar narrated that the Messenger of Allah passed by Sa'd while he was performing ablution and said, "What is this extravagance, Sa'd?" He said, "Is there extravagance in the use of water?" He said, "Yes, even if you are at a flowing river." (Related by Ahmad and Ibn Majah with a weak chain.)

Eye for Waste

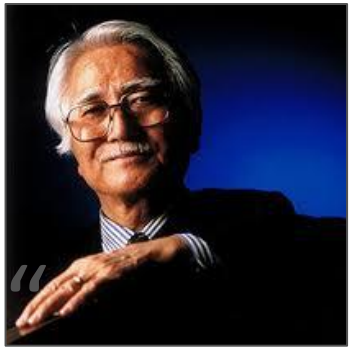
- Waste in hand motion
- Waste in eye searching
- Waste in part location
- Waste in walking
- Waste in holding

改善

KAI=Change

ZEN=Good

“how can we improve something today?”



‘Kaizen is not only continuous improvement.

It is more than that. It is actually **everyday, everywhere, everyone improvement**.’

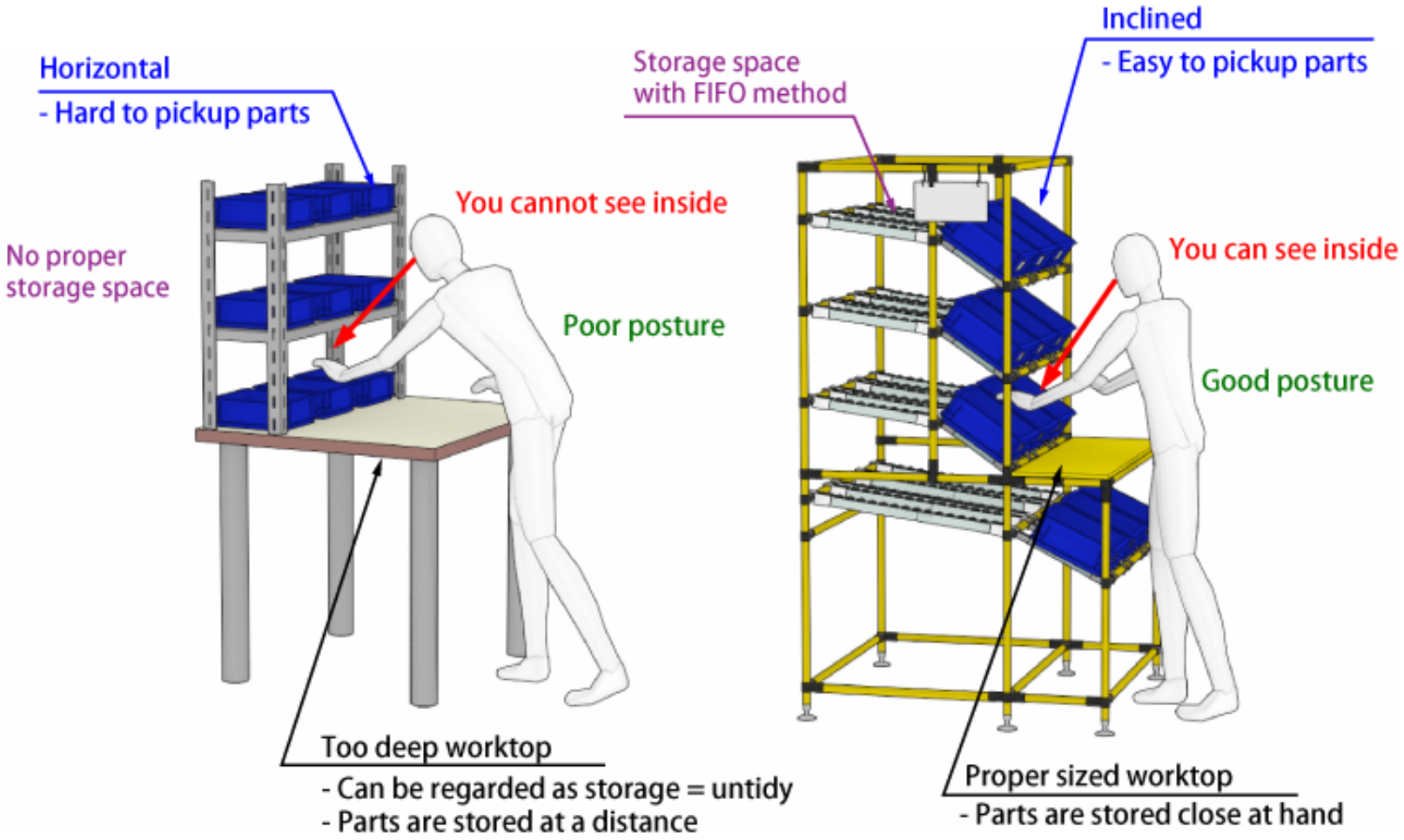
MASAAKI IMAI

Lean Guru, Founder of Kaizen Institute

"Too **many people just assume that things are all right the way they are**. But that way may not be the right way. Kaizen is about **changing the way things are**. If you assume that things are all right the way they are, you can't do kaizen. So change something!"

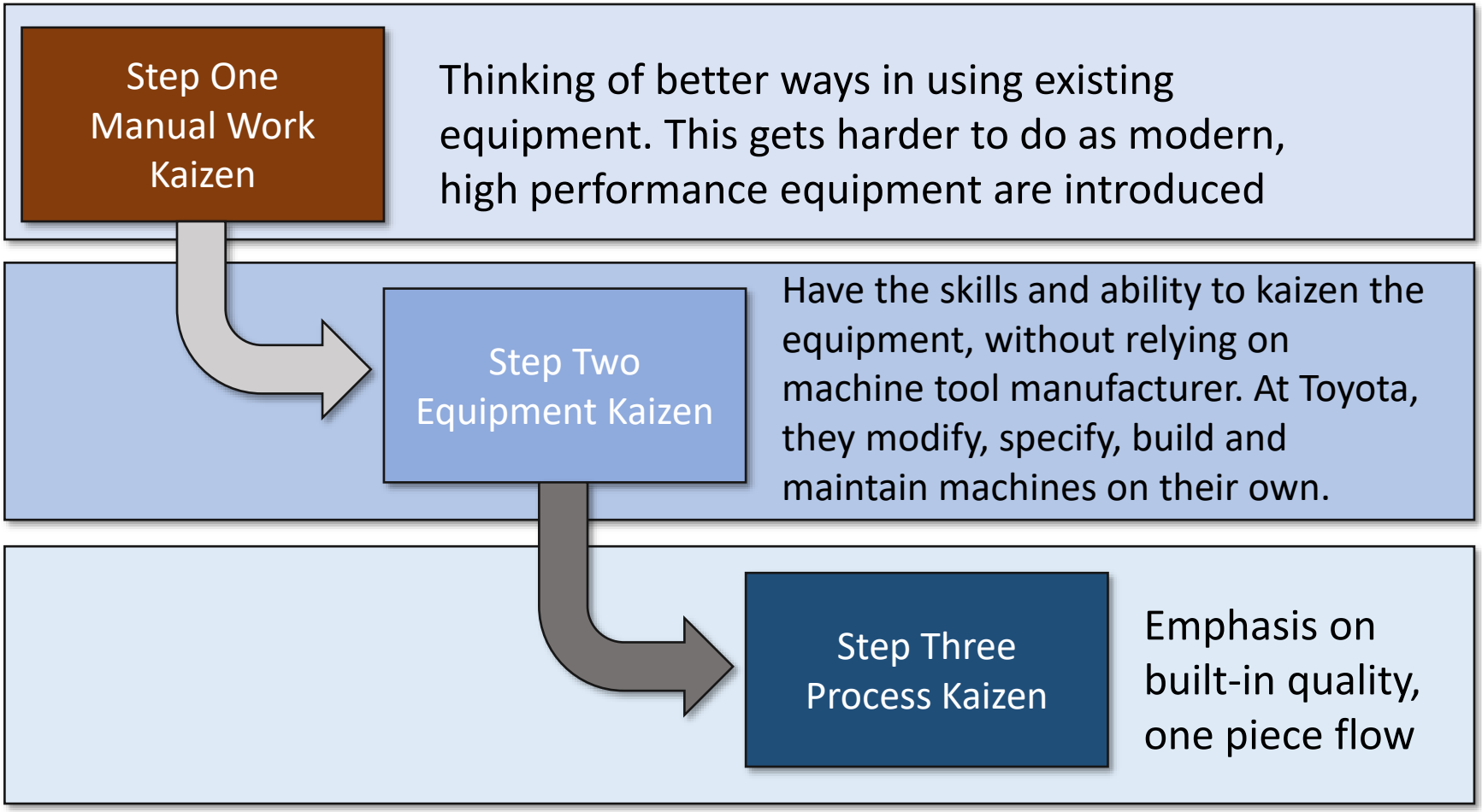
TAIICHI OHNO

Father of Toyota Production System


Horizontal
- Hard to pickup parts
No proper
storage space
You cannot see inside
Poor posture
Too deep worktop
- Can be regarded as storage = untidy
- Parts are stored at a distance
Storage space
with FIFO method
Inclined
- Easy to pickup parts
You can see inside
Good posture
Proper sized worktop
- Parts are stored close at hand

What to Kaizen?

3 sequential steps to Kaizen.



How to Kaizen?

Go to actual location to see and understand the actual situation = **Genchi genbutsu**

How to understand actual situation?

"Ask, **What happened? What did I see? What are the issues?**

At the root of all this, to make **decisions based on factual information,** not based on theory.

Some will say common sense will provide the solution, but collecting **data and analysis** will tell you if your common sense is right."

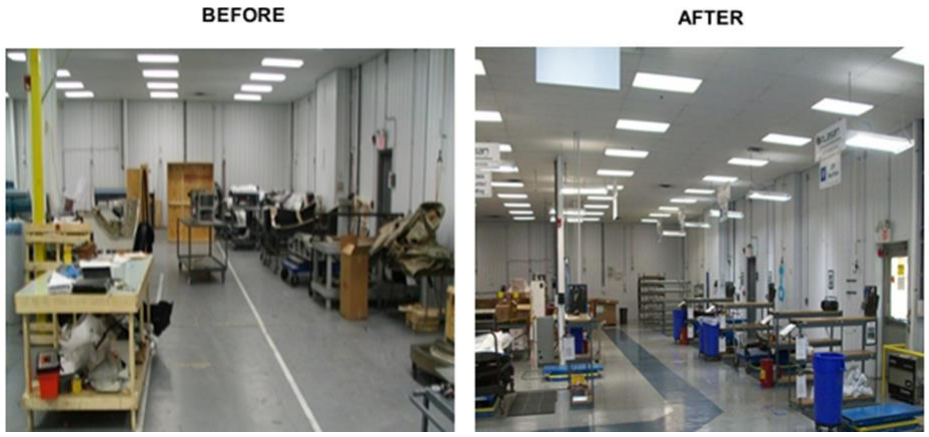
Tadashi Yamashina, President of Toyota Technical Center

Ask penetrating questions, i.e. Why do you do it that way?
Ask many layers of "5 Whys" to get to the source of the problem.
Challenge conventional assumptions. Consider many alternatives.

Visual Management - 5 S

Eliminates the waste of looking and searching for equipment. Pride and personal ownership of the workplace, good foundation for improvements

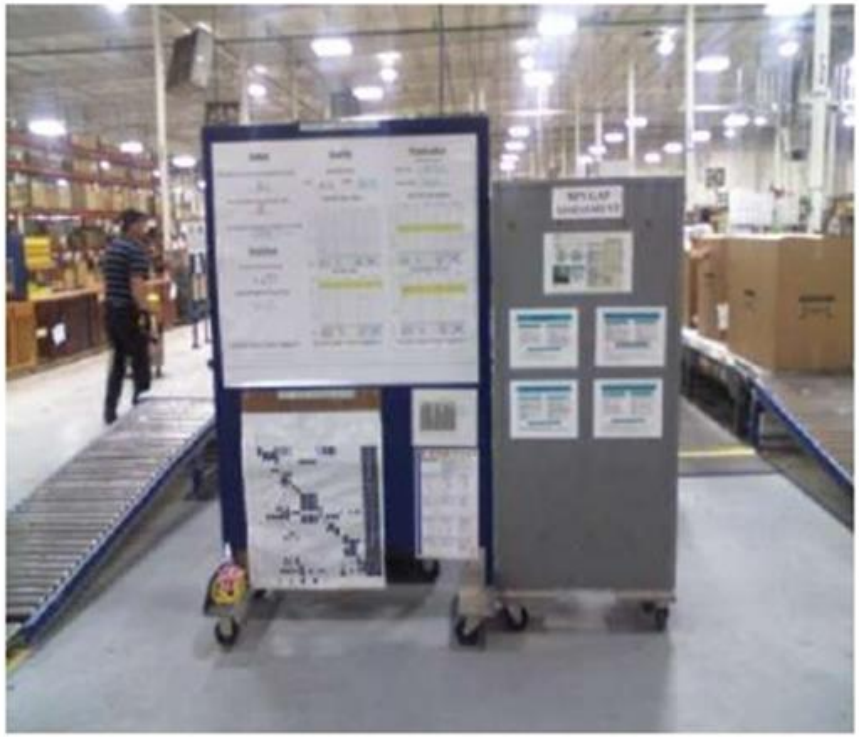
Seiri /Sort – determines necessary equipment & materials.
Seiton / Set in order – optimum organization.
Seiso / Shine – thorough cleaning and inspection.
Seiketsu / Standardize – develop a standard and conduct regular audits
Shitsuke / Sustain (discipline – make 5S part of everyday



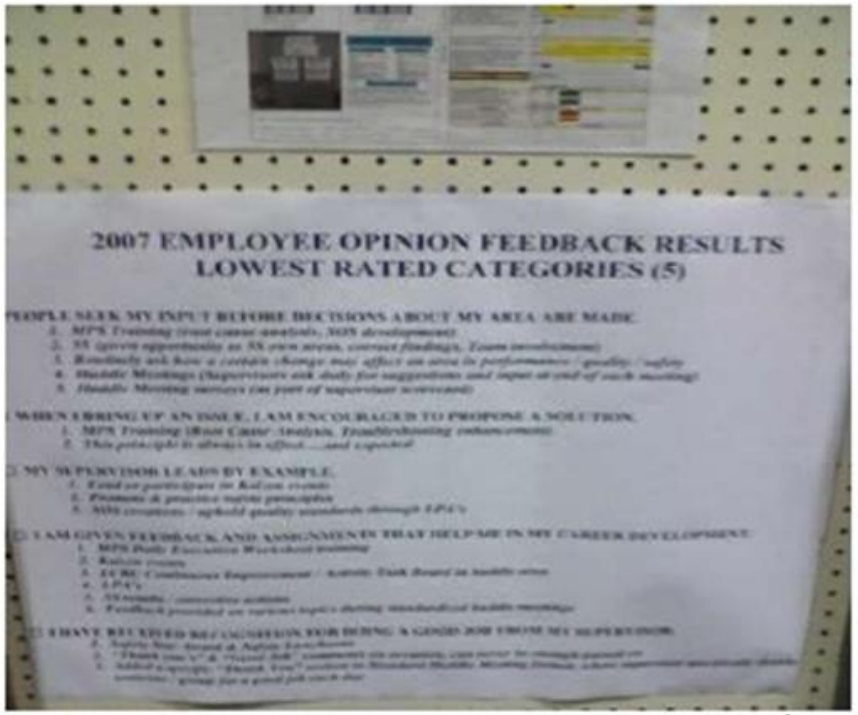
Visual Factory – Performance at a Glance:

How are we doing? Where are we going?
Plant-wide Score Board. Employee Satisfaction.

Huddle board includes information about safety, incentive payout, cabinets per hour, first pass yield, hpu, 5S, training matrix, last MPS assessment and MPS gap analysis.



Corrective action plan to improve bottom five employee opinion survey categories.



Transfer and adapt lean manufacturing knowledge into Construction Industry – and has started early 2000s

Activity for everyone

Please google any websites relating to **lean construction** and tell me what you found. Examples :-

https://www.planradar.com/what-is-lean-construction-and-how-can-sites-benefit-from-it/

https://leanconstructionindonesia.com/

Lean Construction

- Lean construction (LC) - a method of production aimed at reducing costs, materials, time and effort to eliminate wastes and add value to work and all construction activities
- Desired outcome - to maximize the value and output of a project while minimizing wasteful aspects and time delay.
- Outcome produced when standard construction approaches merged with clear and concise understanding of project materials and information, and concise planning and control
- Use what is necessary without extra

Lean Construction Institute

Transforming UK Construction

The **Lean Construction Institute UK** is a charitable membership organisation supporting research into and dissemination of lean construction principles and best practice with a view to improving public sector construction.

Our aim is to provide those commissioning and delivering public works with the information necessary to make informed purchasing and delivery decisions for the public benefit.

Lean thinking maximises customer value while minimising waste. Increasing value for the customer while employing fewer resources and creating less waste.

Lean training standards

In collaboration with the Construction Industry Training Board, LCI-UK has developed a range of short-course Lean training standards that can be delivered by approved training organisations (ATOs).

Lean Construction Module 1: Introduction to Lean (GET2677)

On completion of this training participants will be able to:

- Describe basic principles Lean, gained from a simulation exercise
- Outline key principles of Lean and Lean-based process improvement
- List examples of Lean tools
- Describe how Lean process improvement could be applied to their existing business processes
- Capture initial ideas for potential improvement projects.

Lean Construction Module 3: 5S Workplace Organisation (GET2679)

On completion of this training participants will be able to:

- Describe how 5S can contribute to improving performance on construction sites
- Carry out a 5S audit of a work area to identify areas for improvement
- Brainstorm ideas on how to improve their workplace organisation
- Develop an action plan to address issues identified during the 5S audit.

Lean Construction Module 2: Problem Solving and Continuous Improvement (GET2678)

On completion of this training participants will be able to:

- Apply a structured approach to identifying and describing a problem in their work area
- Carry out root cause analysis to identify the reason(s) why the problem occurs
- Apply problem-solving tools to formulate ideas to address the problem
- Draw up an action plan to further investigate and resolve the problem.

Lean Construction Module Lean Construction Module 4: Lean Construction and Waste (GET2680)

On completion of this training participants will be able to:

- Undertake a site walk to identify different forms of waste in their workplace
- Categorise the wastes and brainstorm actions to eliminate or reduce them
- Develop an action plan to implement improvements.

Lean Construction Module 5: Visual Management (GET2681)

On completion of this training participants will be able to:

- Identify where visual management could be applied in their workplace
- Brainstorm ideas for which visual management techniques and tools are suitable for their site
- Develop an action plan for implementing visual management.

Lean Construction Module 6: Standardised Work (GET2682)

On completion of this training participants will be able to:

- Describe the tools used for standardising work processes
- Identify a process suitable for standardisation
- Put in place an action plan to implement standardised work.

Lean Construction Module 7: Collaborative Planning (GET2683)

On completion of this training participants will be able to:

- Describe what collaborative planning is and how it works
- Outline how collaborative planning can add value and benefit on construction projects
- Develop a collaborative plan for their project for the coming weeks, to be used in weekly production control meetings.

Lean Construction Module 8: Value Stream Mapping (GET2684)

On completion of this training participants will be able to:

- Develop a current state value stream map of a simple process
- Undertake a mapping exercise to identify areas of waste and a future state value stream map
- Develop an action plan on how to enhance value-adding steps, and reduce essential non-value adding as well as non-value adding steps (waste).

THE 8 WASTES OF CONSTRUCTION

HOW WASTEFUL IS THE AVERAGE BUILDING SITE?

Business Improvement is making it's way to building sites

We typically think of factories or offices when we think of Business Improvement, but the construction industry is a prime candidate for efficiency! Together with Hochtief (UK) Construction, we explore some examples of the 8 Wastes you find in construction below.

COMPARISON BETWEEN MANUFACTURING AND CONSTRUCTION WASTES

Table 6.1: Comparison of Lean Manufacturing to Lean Construction Waste

Type of Waste	Manufacturing	Construction
1. Overproduction	Production of too many units or parts due to push nature of manufacturing.	Overbuilding a particular aspect of a project, either because it was over-engineered or a process was started before it was really needed.
2. Waiting	Time spent waiting for the next batch of parts to arrive from the previous conversion process. Time spent waiting for a machine to finish.	Time spent waiting for other work crews to finish their particular conversion process so that the next conversion process may begin. Time spent waiting on crew members of a specific team. Time spent waiting for parts or instructions.
3. Transport	Wasted effort to transport materials, parts or finished goods into or out of storage between processes.	Wasted effort to transport building components or tools into or out of job trailers or storage between processes.
4. Extra Processing (Operations)	Doing more work than is required.	Waste associated with rework, re-handling or storage caused by defects in design, fabrication or construction activities.
5. Inventory	Maintaining excess inventory of raw materials, parts in process or finished goods.	Maintaining excess inventory of construction components, equipment or tools.
6. Motion	Waste associated with unnecessary worker/equipment movement between work stations.	Waste associated with unnecessary worker/equipment movement around the construction site.
7. Defects	Repair or rework.	Deficiencies in the finished product that require additional work or rework to correct punch list items.

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Identifying Causes of Construction Waste - Case of Central Region of Peninsula Malaysia

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Universiti Teknologi Malaysia, 81310 Skudai, Johor, MALAYSIA.

Causes of Construction Waste	Mean Rank Value	Rank
Poor site management and supervision	7.17	1
Lack of experience	7.71	2
Inadequate planning and scheduling	7.78	3
Mistakes and Errors in design	8.00	4
Mistakes during construction	8.34	5
Incompetent subcontractors	8.76	6
Rework	9.02	7
Frequent design changes	9.24	8
Labour productivity	9.35	9
Inadequate monitoring and control	9.40	10
Inaccurate quantity take-off	9.74	11
Shortage of site workers	10.09	12
Lack of coordination between parties	10.21	13
Slow information flow between parties	10.61	14
Shortage of technical personnel (skilled labour)	10.91	15
Changes in Material Specification and type	10.93	16
Equipment availability and failure	11.83	17
Effect of weather	11.90	18


住友不動産
住友不動産
住友不動産


住友不動産
注文住宅
J.URBAN
www.sumitomo-rd.co.jp
自転車を除く
土・日曜、休日を除く
7.30－9
セブン定休


住友不動産

The Lean Construction Journal

Lean Management Academy

Lean Management Training to Help Your Business
Eliminate Waste and Increase Profits through Experiential Learning

KAIZEN for the Continuous Improvement of Sustainable, Multi-Generation Businesses

KAIZEN is a Japanese philosophy of continuous improvement. In simple terms,
"Make Things Better".

KAIZEN is the heart of **Lean Management Academy's** core values. Through World-

Lean Management Academy is proud to have coached and trained many companies in obtaining **Official Certifications**.

7-Month Lean Certification Program

Companies who wish to attain **Lean Certification from Malaysia Productivity Corporation (MPC)** may engage us to receive tailored training and professional assistance in documentation and application for the certification.

Lean Management Academy Sdn Bhd, 7-Month Lean Certification Program course content and training programme fee are within PSMB standard and allowable rates, therefore employers can apply for SBL, **100% HRDF Claimable** if they are interested to organise the training for their employees.

LMA shall provide all the needed documentation for the application.

Learn More

Some Of The Clients Who Trust Us

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Lean Construction (Last Planner® System)

What is Lean Design and Construction?

Lean Design and Construction is a production management-based approach to project delivery -- a new way to design and build capital facilities. Lean production management has caused a revolution in manufacturing design, supply and assembly. Applied to project design and delivery, Lean changes the way work is done throughout the delivery process. Lean Construction extends from the objectives of a lean production system - maximize value and minimize waste - to specific techniques, and apply them in a new project delivery process.

As a result:

- The facility and its delivery process are designed together to better reveal and support customer purposes.
- Work is structured throughout the process to maximize value and to reduce waste-at the project delivery level.
- Efforts to manage and improve performance are aimed at improving total project performance, because this is more important than reducing the cost or increasing the speed of any particular activity.
- The Last Planner® System, a registered trademark of Lean Construction Institute (LCI) http://www.leanconstruction.org.

We are approved by the Lean Construction Institute to use the Last Planner® System in Lean Management Training and Consulting

VILLEGO last planner simulation

The Villego simulation allows learners to immerse themselves and experience the difference between traditional project management and the management of production in projects using the Last Planner® System.

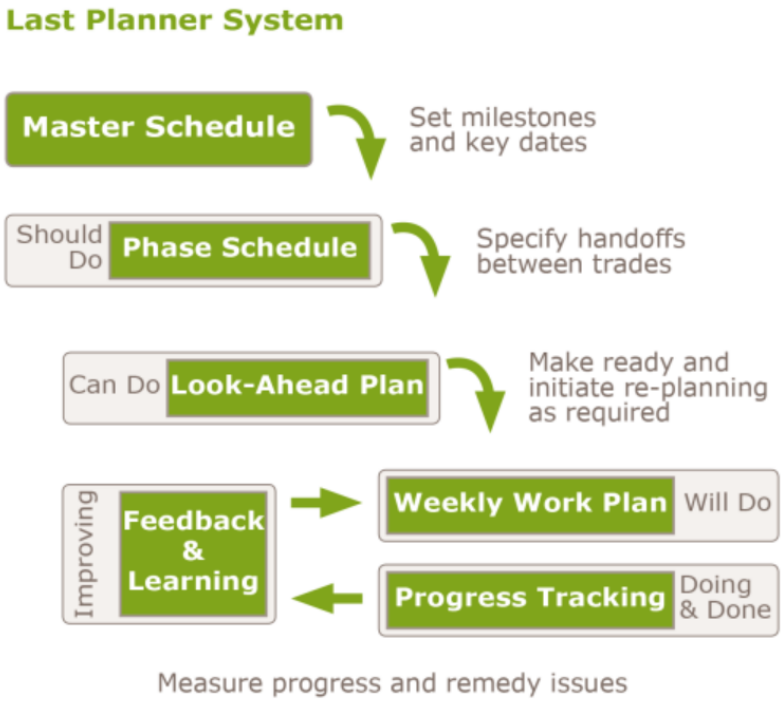
The Last Planner® System, (LPS) is a production management system that can be used on all sorts of projects. In this simulation, the project is to build a house. As with most projects there are a number of autonomous people and teams involved.

Last Planner® System

Overview

The Last Planner® is a production planning system designed to produce predictable work flow and rapid learning in the programming, design, construction and commissioning of projects. DPS' Lean Construction Last Planner® Team are highly skilled and experienced in implementing Last Planner® on a number of projects to date. We listen, therefore we can implement a tailor made solution to suit any construction project.

Lean Construction Institute
Transforming Design and Construction
LAST PLANNER®

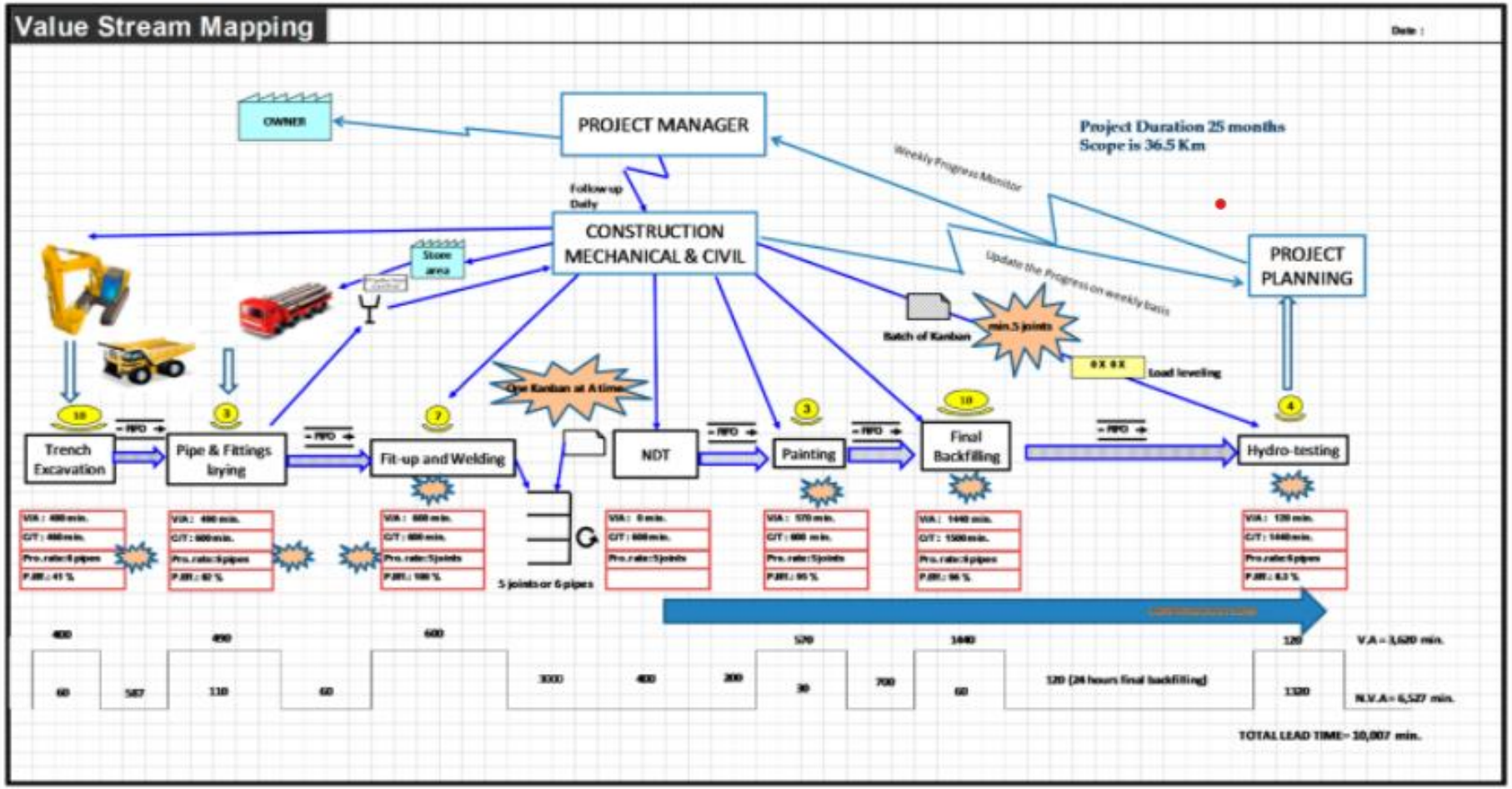


Last Planner® System Overview

Lean Construction Institute
Immersive Education Program

5 Connected Conversations

Figure 8. Future state of VSM for construction of underground pipeline.



Emerging Technologies

in Construction Supply Chain

The following section illustrates the application of some emerging technologies along the construction supply chain. The application of each technology can be used at different phases in project lifecycle. The figure also explains the vertical and horizontal integrations of emerging technologies in a project.

Construction Project Lifecycle (Horizontal Integration)

	Adaptation from RIBA Plan of Work, 2020	**Stage 0-1:** Strategic Definition; Preparation and Briefing	**Stage 2-4:** Concept Design; Spatial Coordination; Technical Design	**Procurement Route:** Procurement Strategy needs to be considered from early stage	**Stage 5:** Manufacturing and Construction	**Stage 6-7:** Handover and Use
	Adaptation from Ozorhon, Abbott and Aouad, 2010)	**Conceptual**	**Planning & Design**	**Procurement**	**Construction**	**Operation & Maintenance**
Actors (Vertical Integration)	Owner / Client Architect Engineer Contractor Manufacturer Facility Management	Client defined value, data driven design, evaluation of alternatives, virtual migration of physical built environment.	Collaborative design, simulation and analysis, integrated models, join reviews and clash detection, design for production.	Lean and BIM based procurement.	Model based collaboration, lean and BIM for production and control.	Facilities management systems integration with BIM.
hnology Cluster	Simulation & Modelling	Building Information Modeling (BIM) Augmented Reality & Virtualization				
	Digitalisation & Virtualisation	Cloud and real time collaboration, Artificial Intelligence, Block Chain, Internet of Things	Big Data and Predictive Analytic		IoT	
	Smart Construction		3D Scanning and Photogrammetry		Autonomous Construction	
			3D Printing & Additive Manufacturing			

Construction Project Lifecycle (Horizontal Integration)

	Adaptation from RIBA Plan of Work, 2020	**Stage 0-1:** Strategic Definition; Preparation and Briefing	**Stage 2-4:** Concept Design; Spatial Coordination; Technical Design	**Procurement Route:** Procurement Strategy needs to be considered from early stage	**Stage 5:** Manufacturing and Construction	**Stage 6-7:** Handover and Use
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Actors (Vertical Integration)	Owner / Client Architect Engineer Contractor Manufacturer Facility Management	Client defined value, data driven design, evaluation of alternatives, virtual migration of physical built environment.	Collaborative design, simulation and analysis, integrated models, join reviews and clash detection, design for production.	Lean and BIM based procurement.	Model based collaboration, lean and BIM for production and control.	Facilities management systems integration with BIM.

What you can do

- Explore New Technologies and Knowledge in different Engineering disciplines - IR 4.0, AI, Digital Construction, etc.
- Develop a Continuous Improvement (Kaizen) System and Culture in your own work and industry
- Develop people improvement skills and knowledge on continual improvement
- Nurture teamwork and spirit to always challenge status quo
- Find new problems or create new challenge to drive innovation

Future Research opportunities

- Lean is practical subject – more industry-based research needed
- Sustaining Excellence (through TPS or Lean/TQM/TPM, etc)
- Human development (hitozukuri) models for different culture and context - Malaysia – foreign labor abundant, skills upgrade costs, attitude towards work – what's in it for me? Education level? Extra work?
- Creating the thinking employees at all levels –How???
- Many more …. Please think and please try

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Analyzing the Association between Lean Design Management Practices and BIM Uses in the Design of Construction Projects	Herrera, R.F., Mourgues, C., Alarcón, L.F., Pellicer, E.	2021	Journal of Construction Engineering and Management
Implementing lean construction techniques and management methods in Chinese projects: A case study in Suzhou, China	Xing, W., Hao, J.L., Qian, L., Tam, V.W.Y., Sikora, K.S.	2021	Journal of Cleaner Production
A study of lean construction and visual management tools through cluster analysis	Singh, S., Kumar, K.	2021	Ain Shams Engineering Journal
On-site factories to support lean principles and industrialized construction	Rosarius, A., García De Soto, B.	2021	Organization, Technology and Management in Construction
A review on the interactions of robotic systems and lean principles in offsite construction	Gusmao Brissi, S., Wong Chong, O., Debs, L., Zhang, J.	2021	Engineering, Construction and Architectural Management
Analysis framework for the interactions between building information modelling (BIM) and lean construction on construction mega-projects	Evans, M., Farrell, P., Zewein, W., Mashali, A.	2021	Journal of Engineering, Design and Technology
Lean practices using building information modeling (Bim) and digital twinning for sustainable	Sepasgozar, S.M.E., Hui, F.K.P., Shirowzhan, S., (...), Yang, L., Aye, L.	2021	Sustainability (Switzerland)

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Sustainability through **lean construction** approach: A literature review

MA Marhani, A Jaapar, NAA Bari, M Zawawi - Procedia-Social and …, 2013 - Elsevier

… **Lean construction**: where are we and how to proceed. Retrieved 26 August 2011 from http://www.kth.se El-zeney, RM (2011). Towards sustainable interior design education in Egypt. …

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A systematic review of **lean construction** in Mainland China

S Li, Y Fang, X Wu - Journal of cleaner production, 2020 - Elsevier

… of **lean construction** in Mainland China. This study contributes to the body of literature on **lean construction** … achieved targets of **lean construction** in Mainland China, and it concludes that …

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A study on the evaluation of implementation level of **lean construction** in two Chinese firms

S Li, X Wu, Y Zhou, X Liu - Renewable and Sustainable Energy Reviews, 2017 - Elsevier

… When we evaluate the implementation of **lean construction** in enterprises, some **lean construction** … Considering the implementation level and maturity of **lean construction** technologies in …

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[HTML] Review of literature of **lean construction** and lean tools using systematic literature review technique (2008–2018)

S Singh, K Kumar - Ain Shams Engineering Journal, 2020 - Elsevier

EMJ - Engineering Management Journal
Volume 32, Issue 3, 2 July 2020, Pages 219-239

A Lean Implementation Success Model for the Construction Industry (Article)

Demirkesen, S.[a], Bayhan, H.G.[b]

Save all to author list

[a]Gebze Technical University, Turkey
[b]Sakarya University, Turkey

Abstract

View references (137)

The philosophy of Lean aims to maximize customer satisfaction while minimizing waste. However, complex, dynamic, and project-based nature of construction projects bring up uncertainties in achieving benefits of Lean implementations (i.e., improvements in the schedule, budget, safety, and quality). The major objective of this study is to propose a comprehensive success model for Lean implementation in the construction industry. Within this context, a set of success criteria are identified based on extensive literature research, and the criteria set are classified into seven categories namely the financial, managerial, technical, workforce, culture, government, and communication. Then, an analytical network process (ANP) model is developed in order to reveal the links between the attributes of success while computing the importance weights of these attributes by the expert team of five. Data used for the ANP model are collected from eight experienced civil engineers through a questionnaire administered in two parts. Delphi method was adopted in the questionnaire administration, where several rounds of questionnaires were sent to the group of experts. Lean training, availability of Lean tools and techniques and market share were found as the most important success factors of Lean implementation. The performance of the proposed model is tested on six different construction projects and the results were evaluated to validate the ANP model. The study is expected to lead Lean practitioners and Engineering Managers with overcoming challenges in Lean implementation process and guide them about success parameters to consider and prioritize tasks when implementing Lean in their organizations. © 2020 American Society for Engineering Management.

SciVal Topic Prominence

Topic: Lean Construction | Takt Time | Value Stream Mapping

Journal of Transnational Management
Volume 25, Issue 3, 2 July 2020, Pages 225-256

Operational excellence through lean manufacturing: Considerations for productivity management in Malaysia's construction industry (Article)

Ibrahim, A.R.[a], Imtiaz, G.[b], Mujtaba, B.[c], Vinh Vo, X.[d], Ahmed, Z.U.[d]

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View additional affiliations

Abstract

View references (149)

The construction industry's work process can lead to the generation of waste which does not add value to the operational performance. The purpose of this research is to study the operational performance of the Malaysian construction industry. Based on the analysis of 296 responses from Grade 7 construction organizations, the data revealed that these construction organizations have applied some lean manufacturing principles in their day-to-day operations. This study revealed that there is a correlation between lean manufacturing concepts and operational performance (OP), thus making a useful contribution to the industry, academia, and society. The future agenda is to improve construction industry performance, which requires joint initiatives between governments, educators, university administration, and industry leaders. © 2020 Taylor & Francis Group, LLC.

SciVal Topic Prominence

Barriers to adopting lean construction in the construction industry: a literature review (Review)

Albalkhy, W.[a], Sweis, R.[b]

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[b]Department of Business Administration, The University of Jordan, Amman, Jordan

Abstract

View references (146)

Purpose: The purpose of this paper is to identify and theoretically explain the general barriers to adopting lean construction practices in the construction industry regardless of the country or the company size or specialization, and to suggest future research studies in this field. Design/methodology/approach: Systematic literature review was conducted to identify and explain the list of the barriers from scientific sources that were published before May 2018. Findings: Twenty-nine barriers were identified and explained, and a proposed model to classify the sources of the barriers was chosen. Seventeen barriers were classified as internal environment-related barriers, five were labor-related, three were materials-related and four were exogenous barriers. In addition, some directions for the future research studies were suggested. Research limitations/implications: The barriers that are related to the advanced levels of lean construction (LC) implementations, to a specific location or to a specific LC tool were excluded. Originality/value: This review will help to increase the understanding of the new concept of LC and might help to encourage the adoption of LC practices. Also, it might be useful for identifying the strategies to achieve successful application of these practices. © 2020, Emerald Publishing Limited.

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Topic: Lean Construction | Takt Time | Value Stream Mapping

Takeaways from this Talk

- Lean offers opportunities to increase productivity, improve quality, and reduce costs through waste reduction
- Lean will improve stakeholders value without doubt
- Lean has been successful used to improve manufacturing, healthcare, financial services, and construction (at least abroad)
- The benefits are visible when implemented clearly, continuously, and with long term perspective of many kinds of gains and advantages

Domo Arigato Gozaimasu
Ganbatte Kudasai
(Good Luck/Do your best)

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