

Toyota production system case study



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1. 1. Introduction

The Toyota Production System (TPS) which was developed by Toyota Motor Corporation in 1970s is the Toyota's unique production approach and it becomes the worldwide application of production system in many companies (Moden, 1991). The main objective of TPS is to improve their manufacturing process by cutting off overburden and unevenness and elimination of waste in the process.

The purpose of this assignment aims to assess the progress of a medium-sized construction company which is working in commercial projects and sometimes on design-build projects. As a representative of youth generation of the company, the author recognises that there are many problems existing in the process of executing a project of the company. Hence, benefit and reputation of the company is seriously affected by their defects on the process.

In this report, the author will investigate all problems in the company in the terms of two phases in a construction project: pre-construction and construction phase. The author afterward will indicates the theory of “lean in construction” to apply in the company in order to solve problems. The improvement of the company will be analysed base on the model of TPS House diagram. Finally, the implementation and further development of the whole process will be discussed.

1. 2. Company overview

In this assignment, the author is going to analyse a construction company as described in assignment scenario. It is a medium sized construction firm

working mostly on traditional office and commercial projects (gained through bidding) and sometimes on design-build projects. As a construction firm, the company is aware of the role of planning is the vital process of any project. Harris (2006, p65) indicated two types of planning which are strategic and operational planning. The first type has been executed by the client and integrated team which involves proposal outline of the project such as scopes, procurement route, time and financing. The operational plan, in contrast, will depict the process achieved in each stage of project in detail. The operation of planning process and involved problems of the company will describe below:

The company has a systematic planning and management system for construction projects, starting from a master schedule and related partial plans for plant, personnel, materials etc. ; plans for shorter term are derived from the master plan, extending to weekly plans, and the progress is monitored and feedback to management.

The current issue is the usage of the plan; it seems not being attracted staffs to the master plan, as people mostly do not study this plan. Even if the master plan is used, all of the tasks in this plan are not sorted in logical way, hence the plan looks chaotically. Consequently, the project cannot go smoothly and the company always meet an anxious rush when the deadline is coming.

The company could starts their construction process in just two weeks after winning the bid, even if the project has been happening for years and it has been designed for one year. So that, sometime the contractor does not have

enough preparation for their work, they will start the work as soon as they can.

Financial control in the company is tight, and every material and work package is procured for its lowest price.

Sometime, the construction works in the site have to be delayed or even stopped due to shortage of material and labour resources in the construction site, especially in big project, those situations happen regularly.

The communication on the site is not really good. It is the lack of collaboration among sub-contractors.

The site personnel of company often seem to be exhausted by long hours and constant troubleshooting

The company seems too difficult to adapt the design and build projects when they are the D&B contractor of a project. This thing results from insufficient of design experience control of the company and the management experience of D&B procurement method which is very popular in construction industry in the United Kingdom

Finally, the amount of physical waste transported from site is very lager; moreover the benefits from tight financial control seem to be lost by such cost leaked.

As shown in the description above, it is obviously to see that the company has many disadvantages in order to manage a project. In the later parts of

the assignment, the author will try to analyse particular problems and make improvements based on the Toyota Production System theory.

Chapter 2: Analysis of production process in the company

2. 1. General outline of the process map

Oberlender (2000, p140) concluded planning is the vital process of any project, the better planning is, the better project is achieved. In a construction project, Harris (2006, p65) indicated that there are two types of planning which are strategic and operational planning. The first type has been executed by the client and integrated team which involves proposal outline of the project such as scopes, procurement route, time and financing. The operational plan, in contrast, will depict the process achieved in each stage of project in detail.

In this assignment, the whole map of operation plan in construction process which is include the planning and execution process and the service procurement process will be drawn and analysed in order to make the appropriate improvement of the company.

2. 2. Current process of the company

In this assignment, the author is going to use UML activity diagrams to illustrate the map of pre-construction and construction processes.

Fig 1 below show processes of construction project including pre-construction and construction stage which is applied in the company.

Figure 1: Pre-construction process

Figure 2: Construction process

2. 3. Analysis of pre-construction process (1-12)

2. 3. 1. Description of the map

In the pre-construction stage, the company will divide construction work into many work packages and develop plans for tendering. They have to prepare all the information about project and open a tender; finally they will choose suitable sub-contractors and material suppliers. There are two main phases of this stage which are production information and tender action.

Production information: normally, the D&B contractor will divide the whole work into many work packages with information of work, responsibility, schedule and the cost for each package. The purpose of this phase is to help all the sub-contractors understand and prepare what they have to do with their package. However, to do this, sub-contractors need to prepare and win for the tender of those packages. Even three principles of a good project which are time, quality and cost are considered; the company always put the low price as the top of priority.

Tender documentation and tender action: the company will be the client of work packages which are executed by sub-contractors. Sub-contractors are required to spend time to study product documents as they want to take part in the tender i. e. work packages. They also need to prepare the tender document and arrange for their own plan of works before they submit those documents to main contractor. Based on the quality of the tender documents and the reputation of sub-contractors, the company will select suitable contractors for each package and prepare the contracts with them. Normally, the contractors which offer the best price will be selected.

2. 3. 2. Existing problems in the process

There is insufficient information from the company in tender action; moreover the company really focus on the cost and the “ lowest price” contractor would be selected. Consequently, many aspects of project have been neglected i. e quality and time.

2. 4. Analysis of construction Stage (13-49)

2. 4. 1. Description of the process

This is the main stage of any project with the end product is the whole CTG. The stage starts when the company establishes contract to sub-contractors which was indicated in the previous stages. Sometimes the design changes or the design teams make some modifications. The changes in design in D&B procurement will lead to many risks to client, so that before executing the works, main contractor and sub-contractors should spend time to review the detail design and make recommendation in order to avoid the risks. During the stage, the company is the main actor who arranges the site, and executes main works such as excavation, main building structure and so on; meanwhile sub-contractors should have their own plan for implementing their works at the right time.

According to Angus (2003, p137), in this stage, changes may be obliged in either term design or construction even they are not expected in advance. If the changes happen, the cost of the project will change, the result may be serious in D&B procurement method. Hence, in this stage, correct planning and sufficient controlling can be the most critical issue to achieve the construction of project. Whenever, the change is achievable, all of the

concerned parties should take part in discussions in order to find a way to reduce the bad effects as much as possible.

The current planning process can be divided by four main parts as follow:

General Master Plans (made 3 monthly for the whole life time of the project; process 13-16): Planning department under the control of project manager will develop the master plan in order to make sure the project will be executed within the specified constrains with the association of health and safety problems (Mawdesly, 1997).

Develop Sectional Master Plans (made monthly for the next 3 months; process 17-25): The General Master Plan will be developed by the planning department based on the general master plan and scopes which are issued by Project Manager (Mawdesly, 1997). More detail plan for personnel, labours and material will be extend to ensure that aims of general master plan will be attained. Once all the departments receive the sectional master plan, they have to review the plan and make revisions in order to make a feasible plan for the whole teams.

Develop Weekly Plans (made weekly for next 3 weeks; process 26-36):

Weekly plans are derived from the Sectional Master plan. All the involved parties have to develop their own plan and make the recommendation to Planning department in order to establish an appropriate plan. According to Mawdesly (1997, p10) the weekly plan have to ensure the efficiency of resources indicated from the previous plan so as to reach the project objectives.

Construction process (36-48): The construction works begin with the preparation of construction site. As the main contractor, the company will execute all the main work on site, meanwhile other contractors (sub-contractors, material suppliers) need to have plan to deliver their products as indicated on their plans. Every week, all of the contractors require issuing the progress report and sending them to project manager and client's organisation in order to control the construction works. This schedule, according to Mawdesly (1997), there is little change of the plan because it will badly affect to construction progress of a project when uncertainty happens.

2. 4. 2. Problems happen in the process

The company always implement the project very soon after they win in a tender, sometimes they could not gather adequate inputs from involved parties. As the result, less realistic and practical schedule are issued.

Due to the lack of communication among parties in the project organisation, the general master and the sectional master plans are not appropriate and the conflict happens within sub-contractors.

There is not enough update for weekly schedule because of deficiency of attention on planning and the shortage of management skills. Thus, uneven workloads are unavoidable and almost sub-contractors have to rush near the deadline in order to finish works. As consequent, many critical aspects of successful project such as quality and time are not guaranteed.

The company put the low price tender at the top of priority results in huge amount of unused inventory in construction site. Hence, in every project,
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there is large number of wastes occurring. In addition, lowest price will result in bad quality of material using in projects.

As indicated above, an inappropriate schedule will lead to a problem of material distribution which is sometimes there are superabundant materials on site whereas sometime lack of material. All those things have bad results in bad performance of the construction process.

2. 5. Other problems in construction site

2. 5. 1. Team work and collaboration

As mentioned in the company overview, the communication and collaboration among parties in a project is not good. This problem results in many errors on the construction site and when the argument occur the progress of construction will be affected.

2. 5. 2. Staffs motivation

The assumption of the company indicated that their staffs are not interested in making plan scheduling for the project and they seem not to have enough motivation to contribute to the development of those plan. There are many reasons cause the low motivation of staffs. One of them may come from the lack of communication and team-work among members; staffs sometimes do not know what they should do. The poor quality of plan is also another reason for the motivation of staffs.

2. 5. 3. Physical waste on site.

Based on the theory of Toyota production system which was presented by Liker, J., K. (2004), there are seven type of waste (Muda) in this scenario, they are:

- Overproduction
- Waiting
- Transportation
- Inappropriate processing
- Unnecessary inventory
- Unnecessary movement
- Defects

In this assignment, those issues below are main reason for physical waste on site:

Unnecessary transport or conveyance; Excess inventory and Unnecessary movement: Due to poor quality plan schedule (in both sectional and weekly plan), the plan of delivery material is not suitable, resulting in those type of wastes.

Defects: The bad quality material and design will cause many defects to the project. Hence, reparation, re-construction or replacement of any structures will increase waste in project.

Chapter 3: Toyota Production Lean Principles

3. 1. Introduction into Lean Principles

According to Liker (2004), the major idea of Lean production is to maximise the value for customer while getting rid of waste added in the

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production process. In the other ways, lean production indicates producing more value for customers with fewer resources.

The lean production, in other words “ Toyota Production System or TPS”, were firstly adapted by Toyota, the biggest car manufacture in the world when they developed a new mode of production, in which they focus on the customers and endeavour to reduce all type of waste as much as possible. In their new modes, Toyota has developed such tools which is becoming popular throughout the world, they are: Just-In-Time (JIT), Kanban replenishment system and 5S theory.

The idea of lean thinking was indicated in the Womack and Jones (1996) book, in which there are five principles:

Specify value – An accurate understanding of the precise needs of the customer is required. Hence, the Company needs to find out what the customer wants.

Identify the Value Stream – Value stream is the set of all necessary activities to achieve an explicit product. Womack and Jones (1996) indicated that determining whole value stream for each product is very important step in order to identify muda (waste), maintain the value-adding activities and add more customer value (which should be continuously improved).

Flow – McCarron (2006) concluded that in a process, all activities needs to run in a continuous flow. It means that work flow should be steadily without breaking up.

Pull – Womack and Jones (1996) concluded that it is better the make the customer pull the product rather than let the company push their product. So that, the company will produce what customer needs hence, eliminating waste.

Perfection – Last but not least, is the perfection, it can be described as the right amount of value added to clients. In the whole process, all activities, work flows have to go smoothly with minimising of waste. Moreover, the motivation of staffs needs to be considering.

3. 2. Toyota 14 principles

In the book “ The Toyota Way”, Linker (2004) explained fourteen principles of the TPS, those principles will be summarised with the references of Learning Package 3:

Principle 1: Base your management decisions on a long-term philosophy, even at the expense of short-term financial goals

Principle 2: Create continuous process flow to bring problems to the surface:

Principle 3: Use the “ Pull” system to avoid overproduction

Principle 4: Level out the workload (Heijunka)

Principle 5: Build a culture of stopping to fix problems, to get quality right the first time

Principle 6: Standardize tasks are the foundation for continuous improvement and employee empowerment

Principle 7: Use visual control so no problems are hidden

Principle 8: Use only reliable, thoroughly tested technology that serves your people and processes

Principle 9: Grow leaders who thoroughly understand the work, live the philosophy, and teach it to others.

Principle 10: Develop exceptional people and teams who follow your company's philosophy

Principle 11: Respect your extended network of partners and suppliers by challenging them and helping them improve

Principle 12: Go and see for yourself to thoroughly understand the situation (Genchi Genbutsu)

Principle 13: Make decisions slowly by consensus, thoroughly consider all options; implement decisions rapidly

Principle 14: Become a learning organization through relentless reflection (Hansei) and continuous improvement (Kaizen)

3. 3. Lean production in construction

Bjornfot (2006) stated that lean principles can be applied to construction based on five principle of Lean Thinking that was indicated by Womack and Jones (1996), they are: Value, Value Stream, Flow, Pull and Perfection.

Differences between construction and manufacturing process were mentioned by Cooper (2005) in which he emphasised the lack of co-ordination and communication between parties in construction industry. In

addition, it is not easy to forecast principal aspects of a construction project which are time, cost, quality and profit.

Pheng and Fang (2005) indicated the term of “ lean construction” as a component of construction best practice, moreover, lean construction is a combination of existing principles. The main significant features in which construction industry are different to other industry can be listed as the huge size of project, the stillness of structure and great complexity.

In order to simplify the lean theory applied to construction project, the author decided to use the model of “ Toyota House” to analysis the company problem and indicate improvement for the company. The figure below shows the model of Toyota House which was illustrated by Liker (2004)

Figure 2: TPS House Diagram (Liker, 2004)

To be explained the application of the improvement process, Liker (2004) believed that lean principles will be built as a house model. There are three critical structures: Foundation and two Pillars and they all supported to the roof which is the continuous improvement of the process. If any of three structures is missing or fragile resulting as the improvement cannot be executed. Therefore, in order to improve the construction process, all of structure in the Toyota House should be considered carefully.

3.3.1. Foundation

There are four aspects have to look at in the foundation:

Toyota Philosophy (Principle 1)

Visual Management (Principle 7)

Stable and Standardized processes (Principle 6)

Levelled Production (Heijunka, Principle 4).

3.3.2. Pillars

There are two pillars in the Toyota House model which are: Just-In-Time (Principle 2, 3), Jidoka (Principle 5, 8).

“ Just-in-Time” according to Toyota is the manufacturing of particular what they want to make at an accurate point of time with the exact amounts. Hence, using JIT can help the company eliminate wastes, and unexpected requirements in order to improve production process. Liker (2004) indicated some principles to consider in JIT:

Continuous flow: this ensure the process will finish without any waste of time and material as well.

Takt time: the main part of one piece flow. Takt is the rate in which a product goes through process so as to reach the customer (Liker, 2004)

Pull system: as explained as a principle of Lean production.

Quick changeover: the ability of process to have quick change when required.

Integrated logistics: partners of the company should apply JIT wherever process that they involve in the project.

Jidoka: Following Toyota the term Jidoka is described as “ automation with a human touch”. Womack and Jones (1996) made more clear explanation of “ Jidoka” as the ability of system to stop the work automatically when something wrong happens; otherwise all of products have to be verified with high quality. With the purpose of applying Jidoka, those aspects below need to be considered:

Automatic stops: when any part of the process cannot satisfy the requirement.

Andon: is a caution indicator, it occurs when there is a mistake in the process.

Person – Machine separation: Following Toyota, this feature let people to warn any irregular condition of process and they can stop the operation of machinery so as to reduce the unnecessary waste.

Error proofing: is essential to stop machines automatically.

In-Station quality control: it means the quality control have to be ensured within a stage before it goes to another stages; hence reduce faulty product and waste (Liker, 2004)

Solve root cause (5-why's): The application of 5-why's method is going to be used in this aspect. The problem will be investigate intensely with the purpose of solving problem (Linker, 2004).

3.3.3. Centre

The constituent of this part includes People & Teamwork (Principle 9, 10, 11, 13), Waste reduction (Principle 12, 13, 14), Continuous improvement (Principle 14)

- People and Teamwork:

Selection: It is important to select a person can fulfil the task. Inappropriate person can result faulty, delay and more waste to process.

Common goals: It is obvious that in an organisation, all members must have same goals in order to develop the organisation. Liker (2004) indicated that common goal is speared within the organisation from top to bottom by the supply chain.

Ringi decision making: this aspect ensures that all the people involved to a process should take part in a decision of the improvement. Hence, all possible decisions will be considered.

Cross-trained Persons: ability to be able to perform different tasks to improve quality and productivity. (Liker, 2004)

- Waste reduction:

Genchi Genbutsu: see principle 12 in part 3. 2

5-why's: is a method by asking “ Why” in five times in order to find the original of a problem.

Eyes for waste: it means the company should take time to observe and control waste.

Problem solving: to find the problem at root level. Associated with 5-why's method to have the total elimination of waste.

Chapter 4: Improvement of current processes

4. 1. Lean measurement

Using the model of Toyota House presented in the previous chapter, lean measurement of each issue happened in the process of the company will be evaluate in this part. In the table below, the sign “ x” indicates that we can apply the aspect in with the purpose of improving a particular issue of a process.

4. 2. General improvement of the company

Based on the Lean Measurement table in part 4. 1, the author indicates three aspects that very important for the company in general in which the indications of “ x” are huge, they are:

- People and Teamwork
- Long-term philosophy
- Eyes for Waste

When the company improve any stage of a project, they firstly should consider all of three aspects below. They are the principles for the development of the whole process, and they should take part in every part of process.

4. 2. 1. People and team work

It is evident that people in the heart of any organisation, even in the high-technology era, the position of people is unchangeable in order to create and operate any kind of machine. Liker and Meier (2007) stated that in choosing <https://assignbuster.com/toyota-production-system-case-study/>

an appropriate people with high skills and experiences is the key to achieve a successful process. In order to improve a process, the company needs to develop their staffs first, that is a way Toyota following. Even at that time, the company may not have a good enough staffs for all position. However, the company should have a long-term vision to train exceptional staffs for their important position of the company. Thus, they can improve their organisation. Liker and Meier (2007) suggested the first principle for a leader is the one who has capacity and desire to learn something from other (mean that he is not too self-opinionated). Moreover, Naoum (2001) indicated some more attributes which are:

- Long-term vision which associates to the benefit of the company.
- capacity to make decision
- Confident in his ability and his staffs as well.

Liker (2004) convinced that the development of individual and the improvement of teamwork in the company should go together and have balance between them. According to Hardingham (1995), improved teamwork is able to decrease cost and develop the effectiveness of production process. Additional, Thompson (2000) persuaded the collaboration of the company will be increased when they are successful in teamwork. In order to achieve effective teamwork, he stated some elements:

- The team should share a common goal and has enough ability to achieve the goal.
- Sufficiency of motivation to overcome the mission with high quality of performance.
- Flexible to harmonise their actions and communication.

4. 2. 2. Long-term philosophy

Liker (2004) indicated the long-term philosophy is the foundation of the other principle, so that the short term decisions need to be associated to the long-term vision of the company. As presented in the company brief, now the company really focus on the term of cost in the project, hence the balance among three factors of a project (time, cost and quality) is not guarantee. Following Liker (2004, p114) and Imai (1991, p49), Toyota had serious thinking of making a product which give more value to customers with good quality at acceptable price. Hence, they did not put the price as the top of their company. Based from this study, the author indicates that the company should change the long-term philosophy as the way Toyota is executing i. e. Value for customer and quality of project not only the lowest price.

Imai (1991) stated that the improvement cannot be finished if there is not any standard. Hence, the establishment standard is necessary for any organisation or project in order to make improvements. Moreover, he also concluded the Kaizen (continuous improvement) is called as “ never-ending efforts for improvement”, it can be understood that when a standard achieved, the better standard will be occurred and then this become the next goal of the process. The figure below will show the PDCA cycle or in other words is a Continuation of the Deming Wheel, which indicates the cycle of continuous improvement.

4. 2. 3. Eyes for waste

This aspect was presented in the part 3. 3. 3

The main principle of Lean Production is eliminating waste in process. Thus, it is clear that every people within the organisation should care about waste issue. The company requires ensuring all of their employees and partners must observe any waste in the whole process and do the best to reduce wastes as much as possible.

4. 3. Analysis of improvement in Pre-construction and construction phase

4. 3. 1. Pre-construction Process

As mentioned in part 2. 3, problems existing in this stage of project include which are insufficient information from the company in tender action and the concentration of cost of the company. Hence, the quality of the sub-contractors and suppliers are not very good and sometime they could not afford the quality and time of the project.

In order to improve the tender documents, the company must have standards for their tender, so that when they reach those standards the document will have good quality. Hence, sub-contractors and suppliers have to make their documents carefully before submitting. As a result, the quality of the process will improve. Moreover, using Ringi decision with the participation of all departments involved to project will help the company establish a quality tender document

In the solution for “ choosing lowest tender”, initially, the company should apply the method of “ Solve root cause problems” to find the origin reasons. Using “ 5 why’s” technique is a good answer for this situation. Reasons may relate to the long-term vision of the company in which the cost is focused.

4. 3. 2. Construction Process

The problems in this phase were explained in part 2. 4, in order to solve problems and make improvement, the author will divided construction into many issues and analyse development of each of them. There are five issues in the process:

a. Input for planning process

One of the problems in this process is the lack of input from involved parties, as stated in the pre-construction phase, using “ stable and standardised process” and “ Ringi decision” techniques can be solution for this issue. All the sub-contractors and suppliers should work enthusiastically until they get the standards established by the company, moreover they have to involve to any decision related to their contributions.

b. Updating plan schedule

One of trouble is the implementation of a project is very early so that the company do not have enough time for the preparation of construction works. In addition, weak collaboration between involved parties results to an unsuitable plan schedule (including sectional master plan and weekly master plan).

The first technique can used to improve the situation is “ stable and standardised” technique. It means that when the updating the Master schedule, the company need to attain their standard which is the foundation for any further improvement. The second method is the application of “ Pull system”, the sectional and weekly plan should base on actual conditions on

construction site, the construction department, particularly the site department. To be explained this point, the construction department is the one who control all the works on site, they will have whole understanding of what is happening on site, so they can make an appropriate plan for the project. In addition, all the involved parties such as suppliers, sub-contractors and other departments should have involvement to make a plan that suitable for them. Another issue that is important in this process is the quality of plan. In order to achieve this aim, the application of creating “continuous flow”, “lev