

**The Efficiency Improvement of Cleaning Process on Passenger Train  
by Using Lean Management Technique: A Case Study of Chiang-Mai - Bangkok Route**

**Abstract**

This Bachelor of Technology State Railway of Thailand Project (BTechSRT Project) was a result of Work-Integrated Learning (WIL) under the collaboration between Faculty of Industrial Education and Technology (FIET), King Mongkut's University of Technology Thonburi, (KMUTT), and State Railway of Thailand. This research was based on the concept of lean management (Lean) to analyze the cleaning process management on the train. The objective of this project was to improve the efficiency of cleaning process on passenger train with a case study of Chiang-Mai - Bangkok route by using Lean Management Technique, Value Stream Mapping to classify the value of working process, and Fishbone Diagram to analyze problems by collecting the truth data under simulation. The instruments used for data collection were: 1) the modified checklist of train cleaning process, and 2) a five-rating scale questionnaire of the passengers' satisfaction towards cleaning service of the Chiang-Mai – Bangkok Express Train No.12. The project results indicated that the efficiency of cleaning process after enhancement increased by 5.63% and could reduce 125 minutes of working process. Moreover, the opinion of Chiang-Mai Railway Station officers toward the modified checklist was at a very good level ( $\bar{x}= 4.58$ ), and the overall passengers' satisfaction towards cleaning service of the Chiang-Mai – Bangkok Express Train No.12 after cleaning process enhancement was higher than before cleaning process enhancement, namely from a moderate level to a high level of satisfaction.

Keywords: Efficiency Improvement / Cleaning Process / Passenger Train / Lean  
Management / Value Stream Mapping / Fishbone Diagram

## 1. Introduction

Currently, many governmental and private sectors are striving to improve their efficiency in order to increase the productivity. One activity which is widely used and adopted in most organizations is “Lean Management” which is a suitable technique to modify and improve the operation process within the organization.[1] It can also nurture a better atmosphere of the working place in terms of production line and service because it can provide steps to eliminate wastes in various activities.[2]

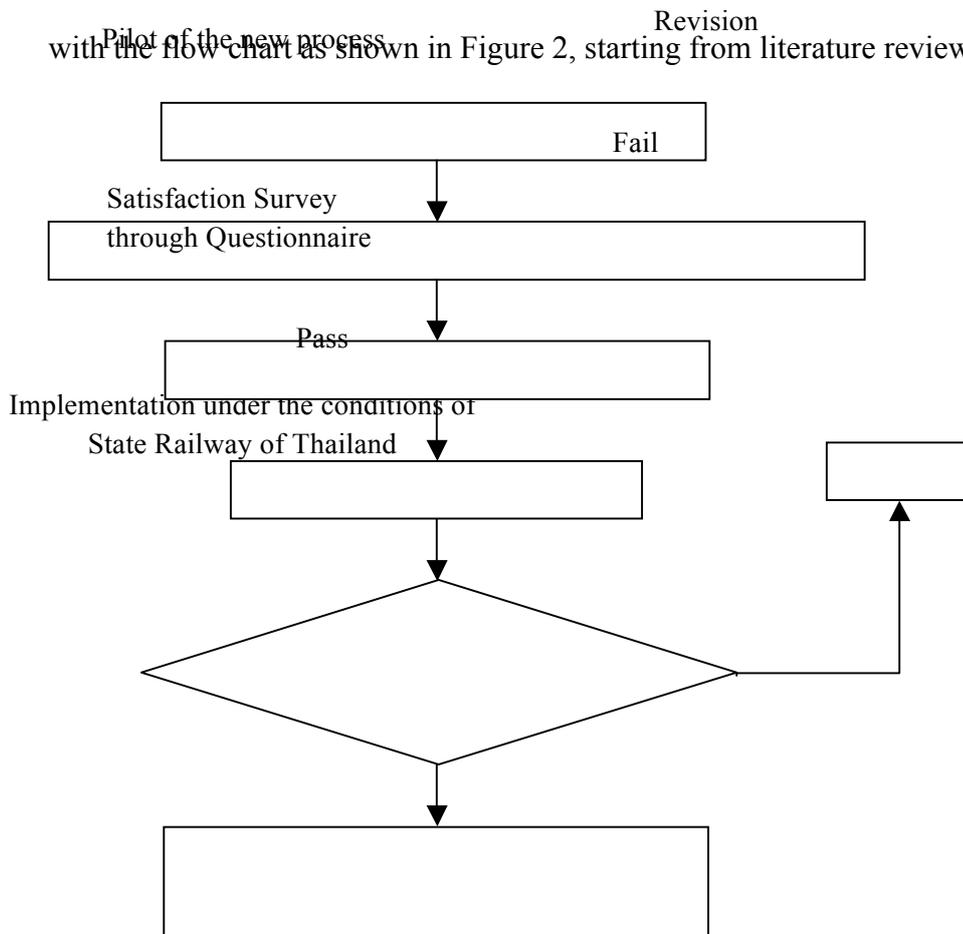
Chiang-Mai Railway Station Office is an organization of State Railway of Thailand and its main duty is to provide service to passengers in terms of commercial and social aspects as well as delivery within the nation. It has many sectors such as ticket office, parcel delivery and relevant services to offer services to people in Chiang Mai Province and nearby regions. During the past few years there has been a sharp increase in foreign tourists in Chiang-Mai areas. The top ten lists of tourists in Chiang-Mai are from China, Malaysia, Russia, Japan, Korea, India, UK, America, Australia and Germany. Chiang-Mai Railway Station Office has always endeavored to improve and develop many services continuously to achieve excellence in service and high quality travel for both Thai tourists and foreign tourists. Still, it has been noted that some aspects of the train service could be improved to gain a higher level of satisfaction from customers, especially the cleanliness on the train. The researchers, therefore, would like to adopt Lean Management Technique along with Lean Value Stream Mapping strategy as a mechanism for simulation to improve the efficiency in the operation and the cleaning process on the train. This could benefit both the working condition of the railway station officers and the service provided to the customers for the prestigious status of State Railway of Thailand.

## Observation of Cleaning Process at Chiang-Mai Railway Station

## 2. Research Procedure

### Designing a Revised Cleaning Process

The researchers conducted this research by following the procedure provided in accordance with the flow chart as shown in Figure 2, starting from literature review to final step.



**Figure 2** The Flow Chart of the research procedure for this research into the efficiency improvement of cleaning process on passenger train: a case study of Chiang-Mai – Bangkok Route

## 3. Research Instrument

The research instrument in this study to improve the efficiency of cleaning process on passenger train by using lean management technique with a case study of Chiang-Mai – Bangkok Route was questionnaire about the passengers' satisfaction towards cleaning service of the Chiang-Mai – Bangkok Express Train No. 12. There were 3 sections as in the external part of the train, the inside of the passenger train, and the toilet. The questions were based on Likert's 5 rating scale. The sampling group consisted of 144 passengers on the Chiang-Mai – Bangkok Express Train No. 12 between 30 May 2014 and 20 July 2014. They were sampled using simple random sampling method based on the estimation table of Krejcie & Morgan.

Cleaning liquid did not meet the standards

Cleaning level did not meet the standards

Lack of knowledge about the standards

Passengers did not take good care

**4. Results**

**Problems with cleaning service**

The study into the efficiency improvement of the cleaning process on passenger train by Repetition of the same chores

using lean management technique along with lean value stream mapping could be presented The set standards could not measure the cleanliness with the results in 3 phases.

**Measurement**

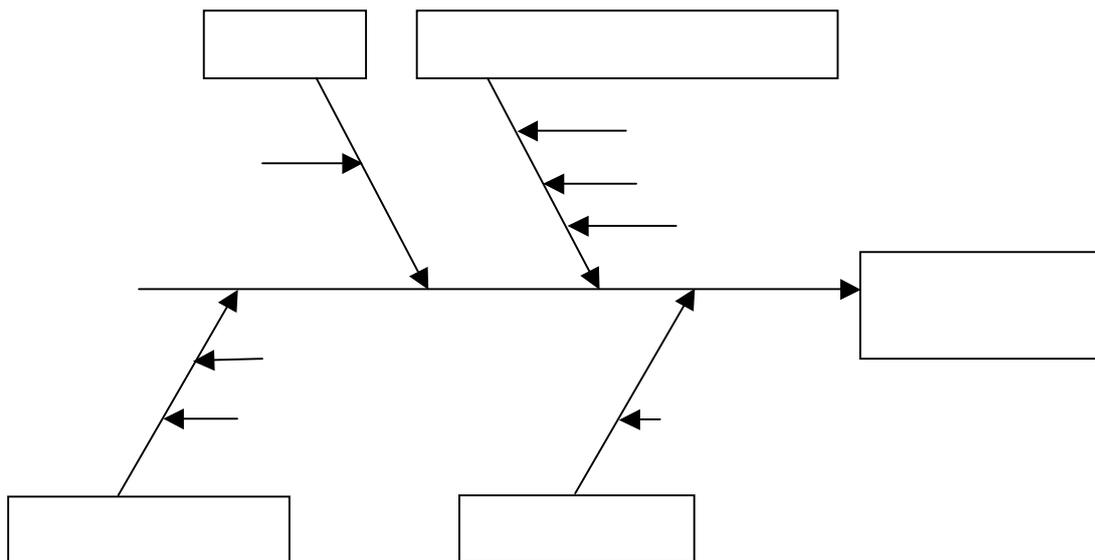
Cleaning Method

Equipment

- Analysis of problems during the cleaning process on the passenger train
- Design of a revised cleaning process on the passenger train by using Lean Value Stream Mapping
- Evaluation of the revised cleaning process

**4.1 Analysis of Problems during the Cleaning Process**

The current situation of the cleaning process on the passenger train was examined and analyzed using a Fishbone diagram with a case study of Chiang-Mai Bangkok Route and the results were as shown in Figure 3.



**Figure 3** Fishbone Diagram of the Problems during the Cleaning Process on the Passenger train

According to Figure 3, the problems during the cleaning process on the passenger train were as follows:

- In terms of materials, the cleaning liquid did not meet the standards
- Railway officers and passengers noticed that the cleaning level did not meet the standards, there was lack of knowledge about the standards and the passengers did not take good care of the toilet
- In terms of equipment, the measurement approach did not work. In this case, it means that the use of checklist equipment did not work as expected.
- In terms of cleaning method, there was repetition of the same chores and the set standards could measure the cleanliness.

Based on all the above-mentioned problems, the researchers decided to solve the problems with cleaning method because these problems were not directly related to personal issues and the organization.

#### **4.2 Design of a revised cleaning process on the passenger train by using Lean Value Stream Mapping**

##### **□ Identifying the Cleaning Process**

In this phase, the cleaning process was identified along with the time for each process in order to create value stream mapping in each working process as well as to measure the efficiency percentage and to revise the process.[3] The details for the operation were given in Table 1. According to Table 1, the Pre-Lean cleaning process could be summarized as follows: Process Time: PT = 415 minutes, Delay Time: DT = 350 minutes, Total Turn around Time: TAT = 765 minutes

**Table 1** The cleaning process before lean management technique [Pre-Lean]

Step					Time (minutes)	Distance (meters)
1. Checking the train before cleaning		■	→	D	30	
2. Telling railway officers to clean		■	→		20	
3. Delivering cleaning vehicles for external and internal parts	●				90	
4. Filling up the train and checking the performance			→		35	20
5. Putting the train in storage			→	▼	350	30
6. Cleaning the internal part of the train	●				180	
7. Checking the cleanliness		■			20	
8. Making improvements in some areas	●		→	D	40	
<b>Total</b>					<b>765</b>	<b>50</b>

**Notes** ● refers to operation    ■ refers to inspection    → refers to movement  
 D refers to delay    ▼ refers to permanent storage

When each step was evaluated in terms of value, non-value and waste, it was found that

- 1) Value includes Step 4 Filling up the train and checking the performance, Step 6 Cleaning the internal part of the train and Step 7 Checking the cleanliness.
- 2) Non-value or required work includes Step 5 Putting the train in storage and Step 8 Making improvements in some areas

As for waste, it was identified according to Value Streaming Mapping based on Downtime as shown in Table 2.

**Table2** Waste Identification based on downtime according to Lean Management Technique with Lean Value Stream Mapping

Waste Category	Waste
Defect Rework	- Another cleaning if it was found to be still dirty by the inspector
Overproduction	- Cleaning the internal and external parts of the train before putting it in storage
Waiting	Putting the train in storage
Not Using Staff Talent	Checking the cleanliness according to instinct rather than standards/criteria
Transportation	Checking performance
Inventory	-
Motion	- Checking the performance of the train - Cleaning the internal and external parts of the train
Excessive Processing	- Checking the cleanliness - Another cleaning activity as a repetition

### Pre-Lean Efficiency Evaluation

$$\% \text{ Efficiency } x = \frac{\text{Total amount of value time}}{\text{Total amount of time for Flow Process from START to END}} \times 100$$

As a result, the pre-lean efficiency before the revision was 31.08

**Table3** The Post-Lean cleaning process on the passenger train

Step				D		Time (minutes)	Distance (meters)
1. Filling up the train and checking the performance						120	20
2. Putting the train in storage				D		350	30
3. Checking the cleanliness of the train and inspecting it						130	
4. Making improvements in some areas				D		40	
<b>Total</b>						<b>640</b>	<b>50</b>

#### Revising the Cleaning Process

The researchers revised the cleaning process and presented it to the committees of Chiang-Mai Railway Station by putting Step 4 with the first order to be followed by Step 5. Afterwards, Steps 1-3 were merged and they were followed by Steps 6-8. Moreover, waste in each step was eliminated as shown in Tables 3-4. According to the Post-Lean cleaning process, it could be shown that Process Time (PT) = 290 minutes, Delay Time (DT) = 350 minutes, Total Turn around time (TAT) = PT+DT or 640 minutes.

**Table 4** The details of the Poste-Lean cleaning process on the passenger train

Step	Details
1. Filling up the train	After the train reached the destination and provided service to the passenger, the train would be filled up and checked for performance
2. Putting the train in storage	-
3. Cleaning the train and inspecting the train	If the inspector supervised the cleaning work according to the standards set by State Railway of Thailand and the revised checklist, there would be no works to do afterwards.
4. Making improvements in some areas	This step was rare because it depended on Step 3. The inspector could take greater care of the operation and the work.

Therefore, the Post-Lean efficiency for the cleaning process was 36.71. It could be seen that the Pre-Lean efficiency was 31.08 and the Post-Lean efficiency was 36.71. Therefore, it could be said that the efficiency increased by 5.63%. The whole cleaning process on the Express Train No. 12 from the first step to the final step according to VSM could be seen in Table 4.[5,6]

According to Table 6, it was found that the overall passengers' satisfaction towards the cleaning service on the train after the revision was at a high level ( $\bar{x}= 3.61$ ). When each item was considered, it was found that Item 1 (the internal wall was clean and there was no stain) had the highest score( $\bar{x}= 3.80$ ). It was followed by Step 2 (the shelf and the handrail were clean)( $\bar{x}= 3.65$ ), Item 3 (the mirror was clean, transparent and without stain, dust or fingerprint and Item 5 (the walkway and the floor were clean) ( $\bar{x}= 3.60$ ), Item 4 (the seat and the feet stand were clean) ( $\bar{x}= 3.55$ ). The item with the lowest score was Item 6 (the bin was not smelling and the rubbish did not fall out) ( $\bar{x}= 3.43$ ). According to the Lean Management Technique, it could be summarized that the process time before the lean management technique along with Lean Value Stream Mapping was used with the Chiang-Mai – Bangkok

Express Train No. 12 was 415 minutes. After the revision, the process time reduced to 290 minutes. The delay time was not improved because the problems were not directly related to the cleaning process and they could affect the organization. The Value Time before and after the revision was the same because the Value Stream Mapping could affect the cleaning service on the Chiang-Mai – Bangkok Express Train No. 12 as shown in Figure 4. Therefore, the revision of the cleaning service on the passenger train could reduce the whole process by 125 minutes and the efficiency increased to be 36.71%.

**Table 6** The mean score and standard deviation of the passengers' satisfaction towards the cleaning service of the Chiang-Mai – Bangkok Express Train No. 12 after the revision

Item	Passengers' satisfaction towards the train (inside)	n = 144 persons		Interpretation
		$\bar{x}$	S.D	
1.	The internal wall was clean and there was no stain	3.80	0.75	High
2.	The shelf and the handrail were clean	3.65	0.88	High
3.	The mirror was clean, transparent and without stain, dust or fingerprint	3.60	0.83	High
4.	The seat and the feet stand were clean	3.55	0.85	High
5.	The walkway and the floor were clean	3.60	0.77	High
6.	The bin was not smelling and the rubbish did not fall out	3.43	0.87	High
<b>Total</b>		<b>3.61</b>	<b>0.83</b>	<b>High</b>

### **The Comparison of the Passengers' Satisfaction towards the Cleaning Service on the Chiang-Mai – Bangkok Express Train No. 12 before and after the revision**

The comparison was as shown in Table 7

**Table 7** The mean score and standard deviation of the overall passengers' satisfaction towards the cleaning service on the Chiang-Mai – Bangkok Express Train No. 12 before and after the revision in each aspect.

Passengers' satisfaction	Before the revision(Pre-Lean) (n =144 persons)			After the revision (Post-Lean) (n =144 □ □)		
	$\bar{x}$	S.D.	Meaning	$\bar{x}$	S.D.	Meaning
External part of the train (Outside the train)	3.15	0.77	Moderate	3.77	0.77	High
Internal part of the train (Inside the train)	3.37	0.85	Moderate	3.61	0.83	High
Toilet	2.51	0.89	Moderate	3.74	0.82	High
<b>Total</b>	<b>3.01</b>	<b>0.84</b>	<b>Moderate</b>	<b>3.71</b>	<b>0.87</b>	<b>High</b>

## Conclusion

The efficiency improvement of the cleaning process on passenger train with a case study of Chiang-Mai – Bangkok Express Train No. 12 by using Lean Management Technique along with Lean Value Stream Mapping could 1) reduce the steps which did not add value out of the process to eliminate waste, 2) merge similar steps in each process and 3) identify and classify each step of the process based on downtime to eliminate waste. It was found that the Pre-Lean efficiency was 31.08% and the Post-Lean efficiency was 36.71%. It could be concluded that after the revision of the cleaning service on the passenger train, the efficiency increased and the total amount of time reduced by 125 minutes.

## 5. References

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