Toyota Philosophy Application in City Traffic Management

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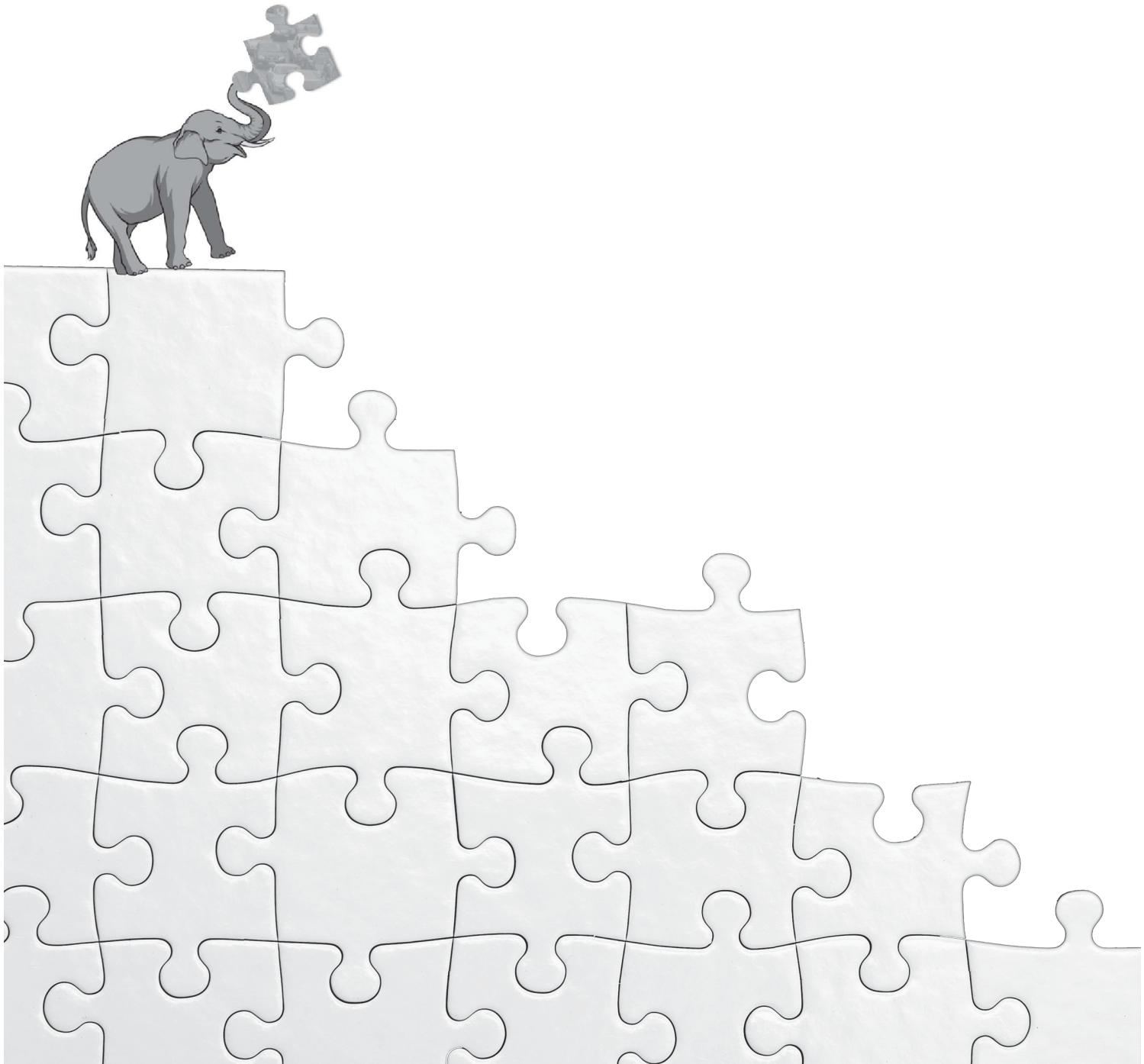


Enhancing Traffic Management through the Principles of the Toyota Production System

The Toyota Production System, also known as TPS, is a manufacturing system developed by the Toyota Motor Corporation. It may seem strange to state that a system aimed at enhancing manufacturing efficiency can also support better traffic management. However, in the Rama4 Model, the project team were able to incorporate various aspects of TPS into our approach to ease congestion on Rama4 road.

For those without a clear understanding of TPS, allow us as Toyota Mobility Foundation (TMF) to share some of the basic concepts of the system. Thereafter we will explain how we used the principles in improving traffic management.

Principles and Key Features of TPS

TPS is based on two main principles: **Just-in-Time (JIT)** and **Jidoka**.

• **JIT means producing the right item, in the right quantity, at the right time**, while minimizing waste and reducing inventory. This is based on the idea that production should be driven by customer demand rather than production goals. This means

that materials and products are only produced when they are needed, rather than being produced in large batches and stored in inventory. By producing only what is customer needed, TPS minimizes waste, also known as Muda of over production, and reduces the cost of inventory management.

• **Jidoka, is a Toyota unique word meaning, building quality into the process by stopping production if a defect** or abnormality is detected. On the other hand, these two principles work together to create a highly efficient and quality-focused manufacturing process with respect for people by eliminate non-value added work by stopping production and abnormality standard.

To achieve the above two principles, various features need to be considered.

An important aspect of TPS is the **concept of continuous improvement, or Kaizen.** This means that every aspect of the production **process is continuously analyzed and improved upon** to eliminate waste and increase efficiency.

Another key concept is **Heijunka,** which means leveling. The goal is to **create a leveled stream of orders and level the workload.** Through the leveling of the workload, it is possible to develop an appropriate standard. Thereafter, if there is any abnormality, it is easy to determine the problem that should be tackled.

Two of the key tools used in TPS are the Kanban system and the Andon system. Kanban is a Japanese word that indicates “signboard” and is a **visual method for managing production and inventory levels.** The Andon system is a visual method for signaling when there is a problem in the production process. When a problem occurs, the **Andon system alerts workers and supervisors, who can then work together to quickly resolve the issue** and prevent further problems from occurring.

TPS also places a strong emphasis on **teamwork and collaboration.** Workers are encouraged to work together to respect each other and solve problems together to improve the production process. This collaborative approach helps to build a strong sense of teamwork which can lead to better overall performance.

Now let us learn how the above principles and features can be utilized for traffic and transport management **to make happiness for all.**

TPS for Rama4 Model

Just-In-Time (JIT)

As explained, at the heart of the JIT philosophy is the idea of minimizing waste while maximizing value. This is achieved through continuous improvement and the elimination of any unnecessary steps in the process. The starting point that was required for the Rama4 Model project team us to incorporate TPS principles were as follows:

1. **Identify the repetitive process** to improve.
2. Identify all the **factors that influence that repetitive process.**
3. **Visualize the process/** value stream mapping to **identify waste and abnormality.**
4. Determine **how to eliminate the waste or streamline the abnormality.**

By using data it was fundamentally possible to gather the repetitive process and the factors influence such process. The Rama4 Model team then worked to visualize the traffic flow to identify the main abnormalities or hot spots.

Gridlock traffic time – showing the traffic flow and abnormalities. This helped us identify the 3 hot spots of (left) Prakanong area, (Middle) On-Nut area (right) Kasemrat area

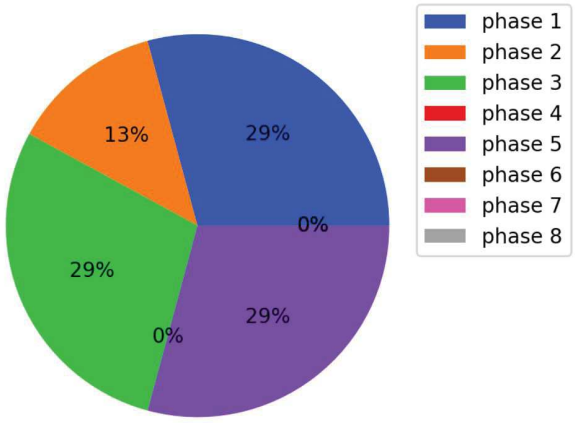
Additionally, in the context of traffic management, JIT could also support:

a) Optimized Traffic Signal Timing: Adjusting traffic signals to ensure a smooth flow of vehicles.

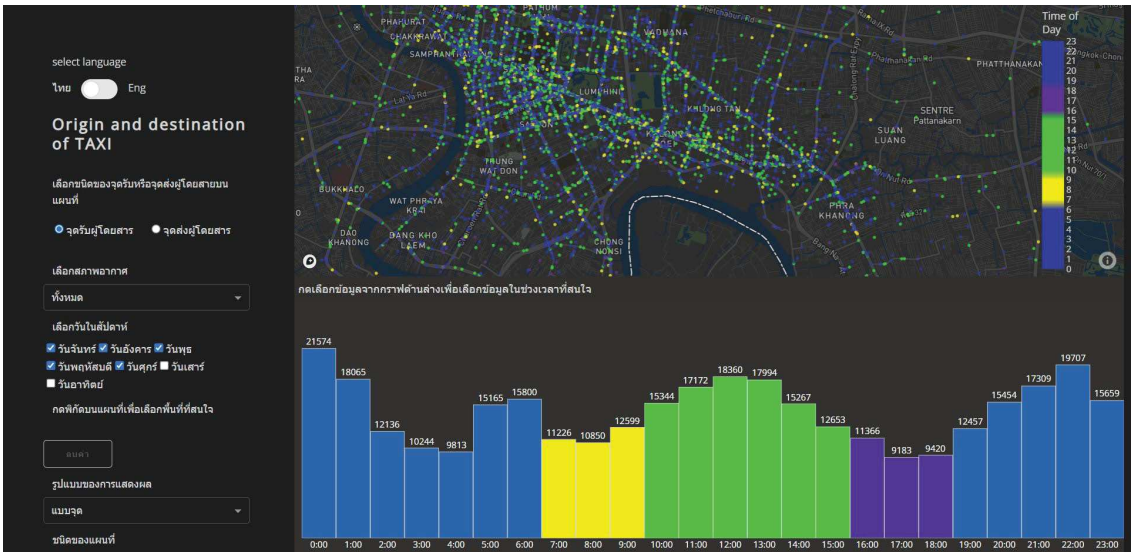
b) Intelligent Traffic Systems: Implementing advanced technologies like Adaptive Traffic Control Systems (ATCS) to collect and analyze real-time data on traffic conditions, allowing for dynamic adjustments to traffic signal timings and traffic flow management.

c) Demand-responsive Transportation: Encouraging the use of public transportation and ride sharing to reduce the number of vehicles on the road during peak hours, thus alleviating congestion and improving overall traffic flow.

Percentage of traffic signal phase on Hua Lamphong junction on morning rush hour



Traffic signal phasing – allowing for clearer determination of ideal time for signal change.



Origin-Destination data that can support demand responsive transport to match demand peaks.

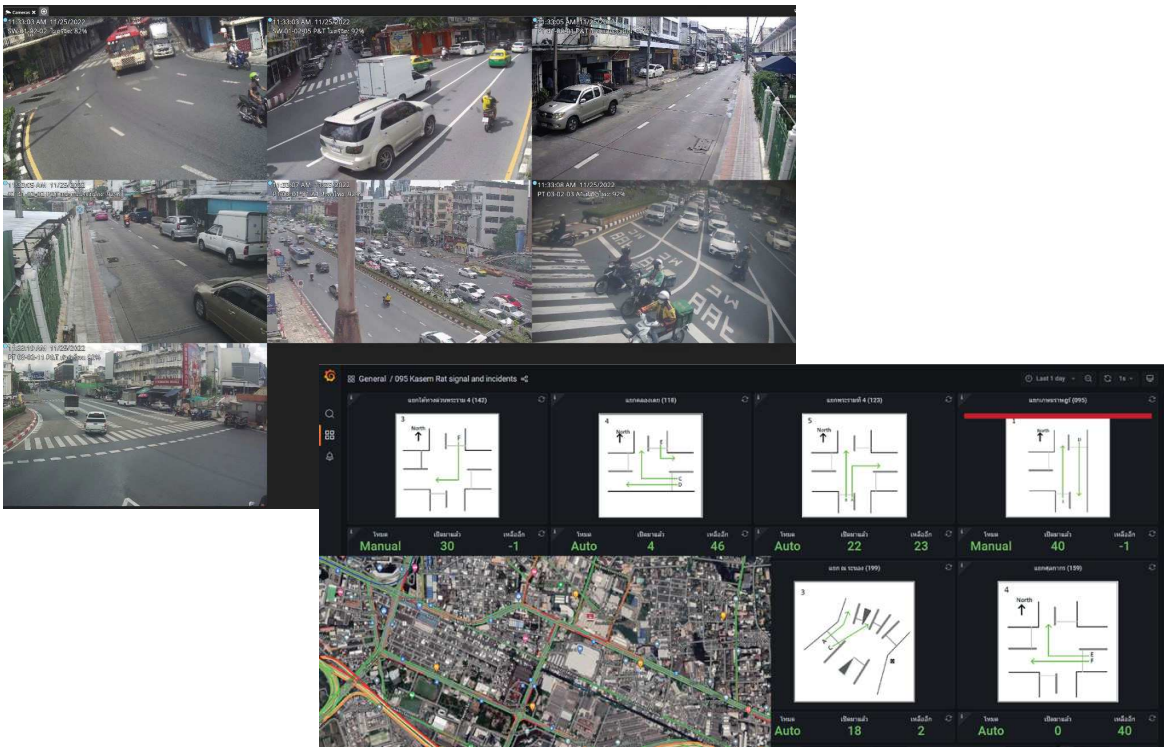
In the Rama4 Model we were able to provide our data for supporting traffic control systems, including in the traffic war rooms, guiding the traffic police as to the best time to change signal by understanding the best way to create levelized traffic in all directions.

Jidoka

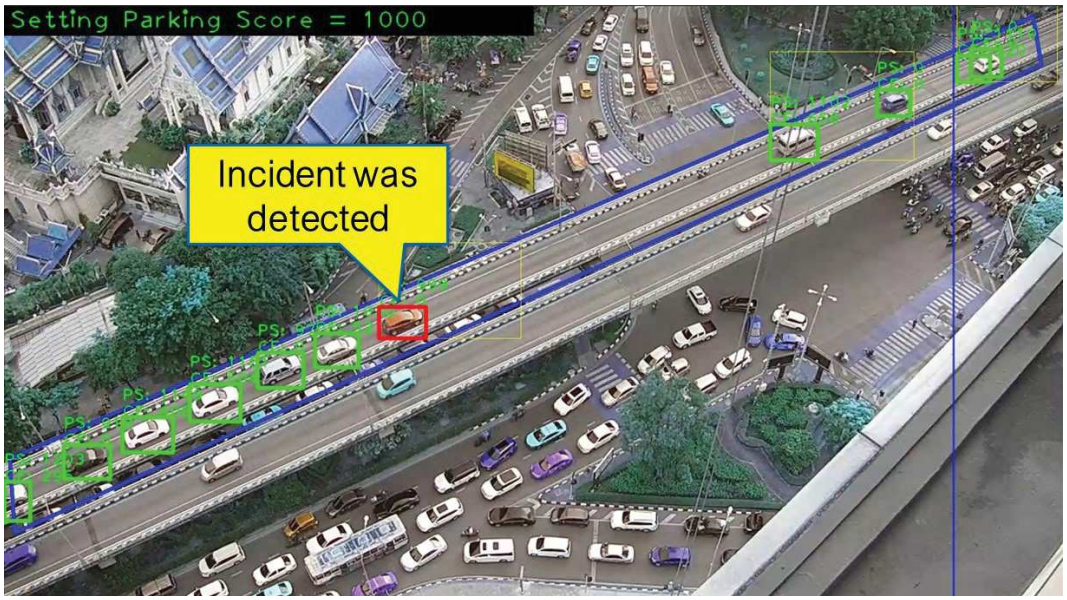
Autonomation or Jidoka emphasizes the importance of detecting and resolving problems as soon as they arise, to prevent further issues down the line. In traffic management, this concept can be applied through:

a) Traffic Management Centers: Establishing centralized control centers to monitor traffic conditions and make real-time adjustments to traffic signals, road signage, and other traffic management systems.

b) Incident Detection and Response: Implementing advanced monitoring systems that can detect traffic incidents in real-time, allowing for quick response and resolution to minimize the impact on traffic flow.



Traffic War rooms – across Rama4 Road



Incident detection through CCTV -AI technology

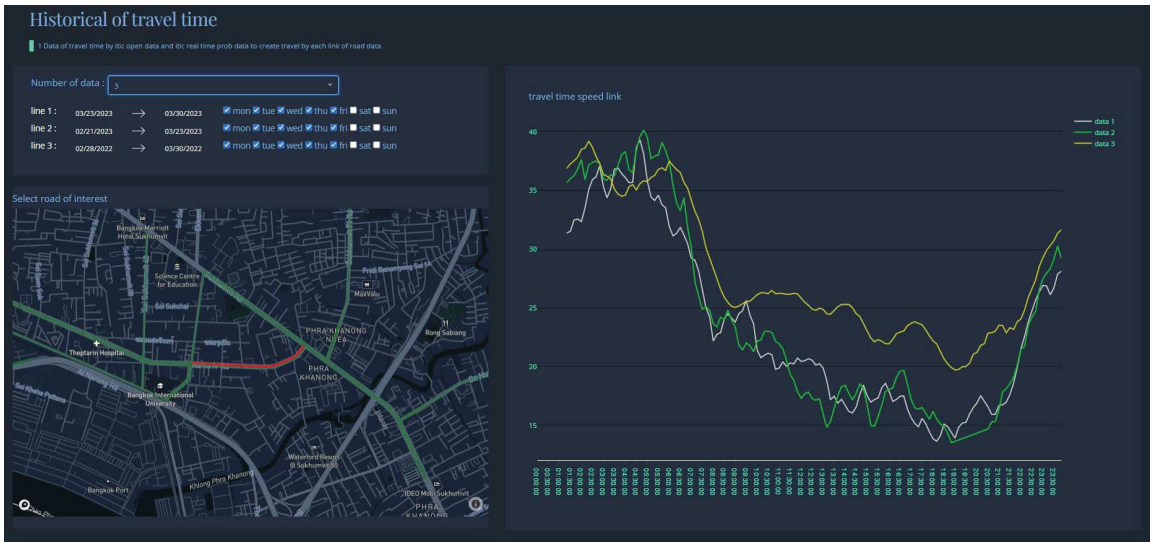
In the Rama4 Model, TMF sponsored the installation of dashboards of 12 junction war-rooms across 7 police districts. Traffic police were therefore able to utilize this information as the Kanban of visualization system for synchronized decision making, including for traffic signal light management and incident management. The Rama 4 project team also made CCTV-AI technology to detect blind-spot traffic flows on the Thai-Japan Bridge to inform Police at Samyan junction that there was an Andon or signal to take immediate action at any incident. This was based on the basic principle of Jidoka.

Continuous Improvement (Kaizen)

Kaizen, or continuous improvement, is a key tenet of the TPS that encourages constant evaluation and refinement of processes and systems. In traffic management, this could involve:

a) Data-driven Decision Making: Regularly collecting, analyzing, and acting upon traffic data to identify areas for improvement and make informed decisions.

b) Cross-functional Collaboration: Encouraging collaboration between different stakeholders, including transportation planners, engineers, and policymakers, to develop and implement comprehensive traffic management solutions.



Travel time data comparison by season, date, time, etc., can see the changing of traffic patterns to ensure the precise effectiveness of our countermeasures. This data can allow us to improve our decision making and continuously adapt our approach among all stakeholders

The Rama4 Model project team fundamentally aimed to make the data visualized so that various partners, including Bangkok Metropolitan Administration, Metropolitan Police Bureau and Ministry of Transport, along with Chulalongkorn University and TMF could work together on appropriate data to take the best decisions (with a human touch).

Respect for People

The TPS recognizes the importance of people in achieving organizational success. It promotes a culture of respect, empowerment, and continuous development. In traffic management, this could involve:

a) Stakeholder Engagement: Actively involving and seeking input from various stakeholders, including residents, businesses, and commuters, in the planning and implementation of traffic management initiatives.

b) Education and Training: Providing education and training opportunities for traffic management professionals and the general public to foster a better understanding of traffic management principles and the role they play in improving transportation systems.

Knowledge management sessions in Rama4 Model with Traffic Police and other partners of the project

Further Considerations for TPS in Traffic Management

The main part that most people do not understand with TPS, is that it is essentially a system about empowering humans and integrating such considerations in planning processes. In that context, the following considerations should be taken into account when adapting TPS principles to traffic management:

a. Traffic management in Bangkok requires the consideration of various modes of transportation, including private vehicles, public transit, Song-taews, bike taxis, cycles and walking. When applying TPS principles, it is essential to integrate these different modes effectively, ensuring that traffic management strategies consider the needs of all users.

b. The transportation sector is rapidly evolving, with new technologies like electrification and autonomous vehicles that may transform the way we move. TPS principles must be applied in a way that is adaptable to these emerging technologies, allowing traffic management systems to evolve.

c. Traffic management is subject to numerous policies and regulations at various levels of government. It is crucial to work closely with all authorities in Bangkok when applying TPS principles and ensure that any proposed changes align with existing legal and regulatory frameworks.

d. A successful traffic management system should be equitable and accessible to all users, regardless of their socio-economic background or physical abilities. All road users are important. When applying TPS principles, it is essential to

consider the needs of diverse populations and work towards creating a transportation system that leaves no one behind.

In conclusion, in the Rama4 Model we could use various insights from the Toyota Production System for improving traffic management, including the unique challenges and complexities of the transportation sector in Bangkok. By taking a holistic approach and adapting TPS principles to suit the specific needs of Bangkok residents, we found that it was possible to create a more efficient, effective, and sustainable transportation system that benefits all users and contributes to a more livable, resilient urban environment.