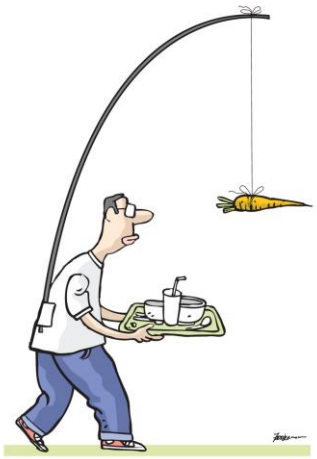
Problem 11

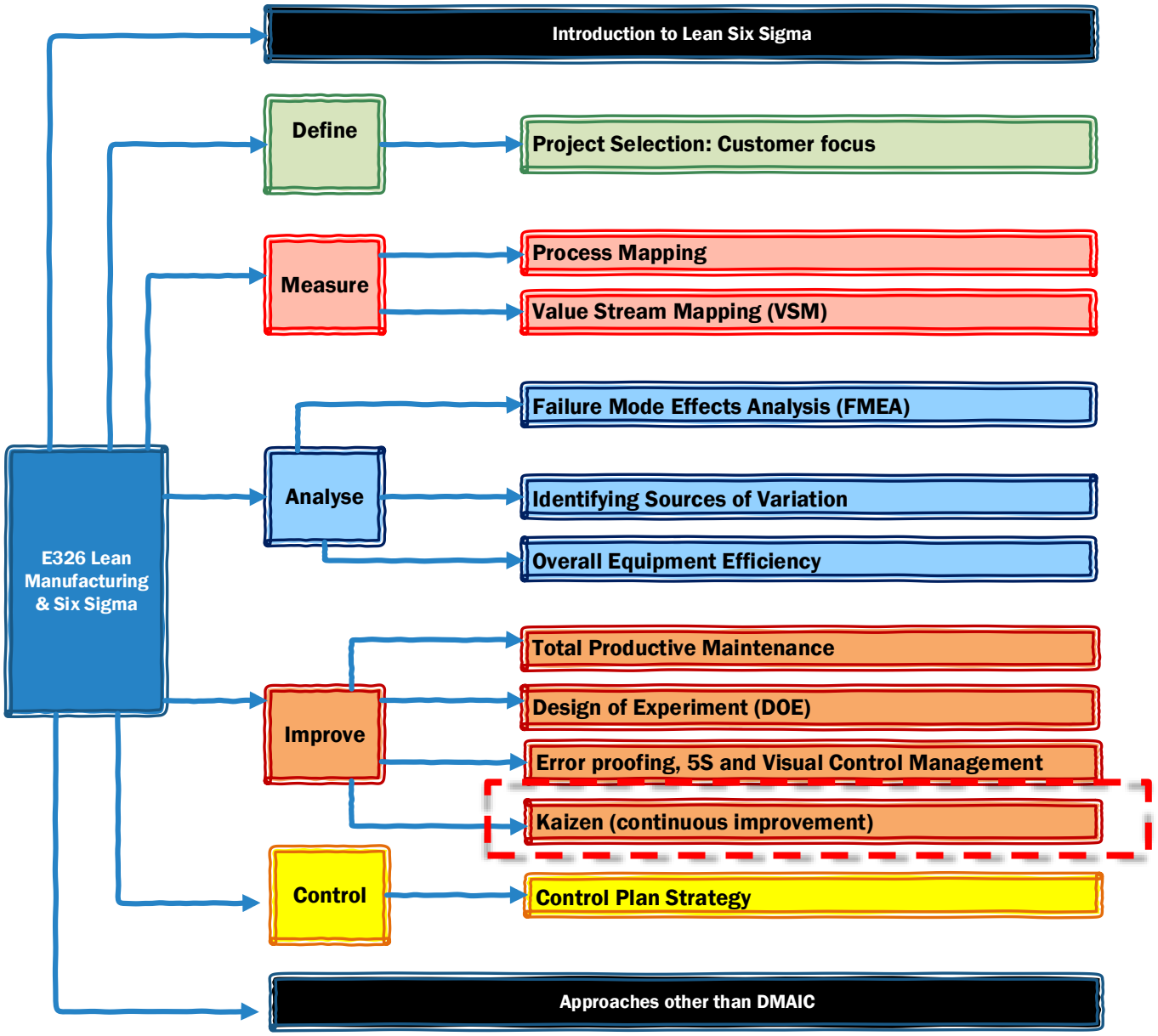
Keep On Improving

E326 – Lean Manufacturing & Six Sigma

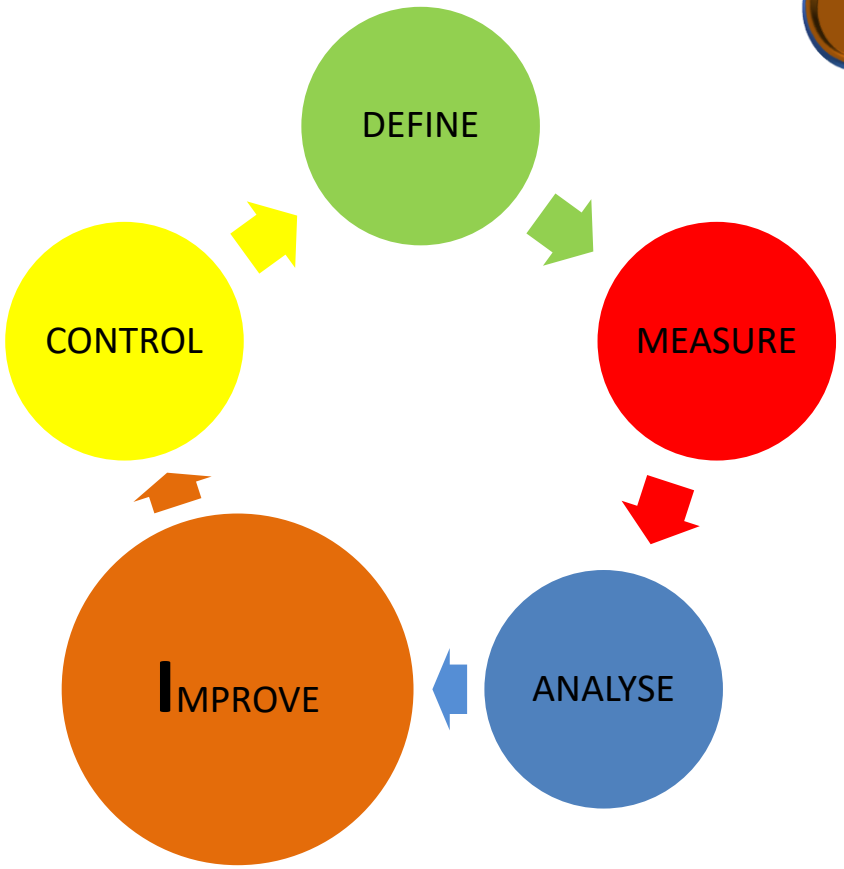


SCHOOL OF ENGINEERING

E326 Lean Manufacturing and Six Sigma Topic Tree



DMAIC

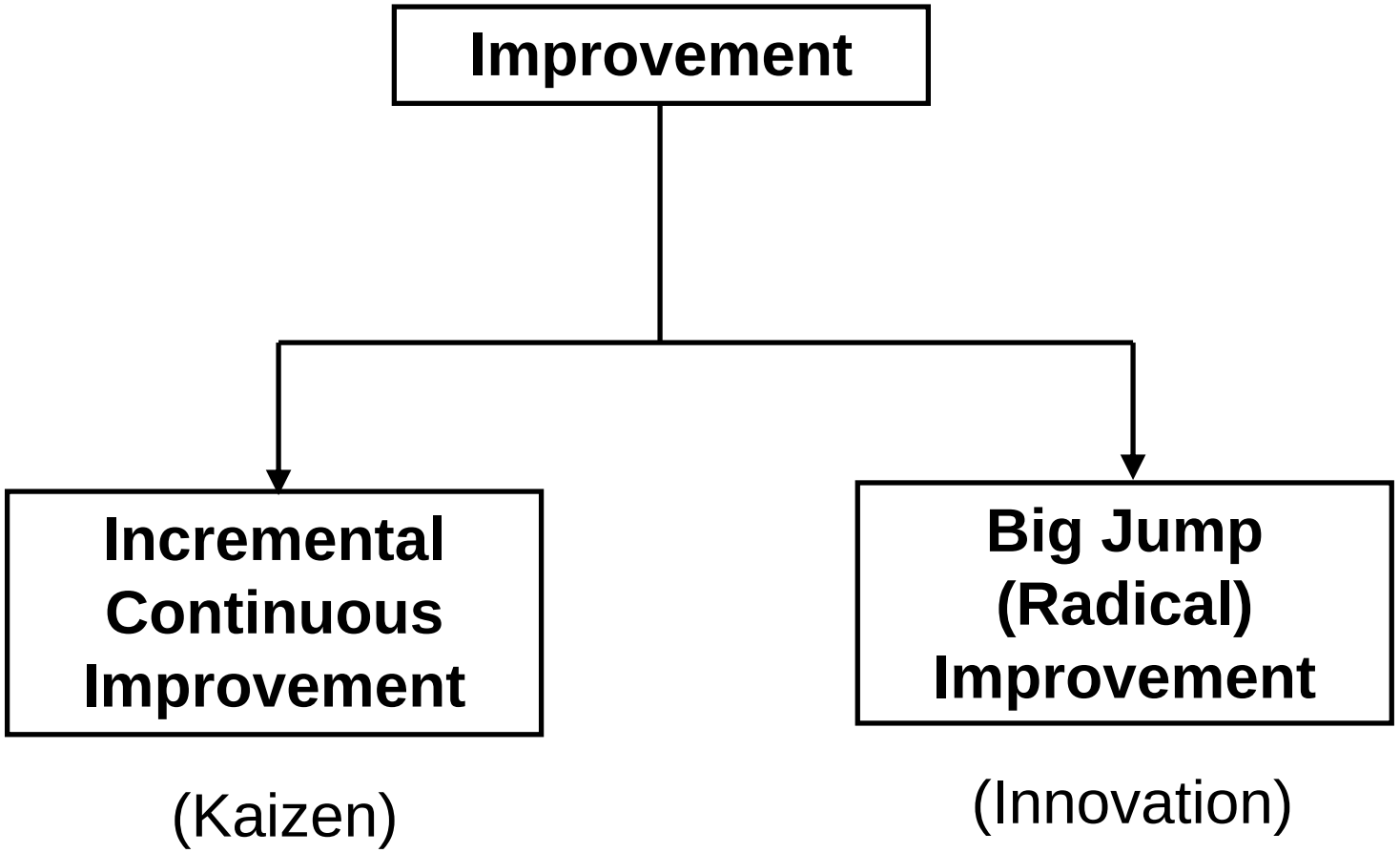


- Kaizen

Objectives of Improve phase:

- To identify, evaluate, and select the right improvement solutions
- To develop a change management approach to assist the organization in adapting to the changes introduced through solution implementation

Scale of Improvement



Standard Work / Standardized Work

- Standardized work is one of the most powerful but least used lean tools. By documenting the current best practice, standardized work forms the baseline for Kaizen. As the standard is improved, the new standard becomes the baseline for further improvements.
- Basically, standardized work consists of three elements:
  - TAKT time, which is the rate at which products must be made in a process to meet customer demand.
  - The precise work sequence in which an operator performs tasks within TAKT time.
  - The standard inventory, including units in machines, required to keep the process operating smoothly

Benefits of Standard Work / Standardized Work

- Create baseline for Kaizen
- Define efficient work process that are repeatedly followed by workers – minimize variability
- Aims to maintain productivity, quality, and safety at high levels – Hold the gain
- Maintains organizational knowledge
- Provide a basis for employee training
- Eliminating wasteful motion
- Core foundation for almost all other principles of Lean Six Sigma

What is Kaizen?

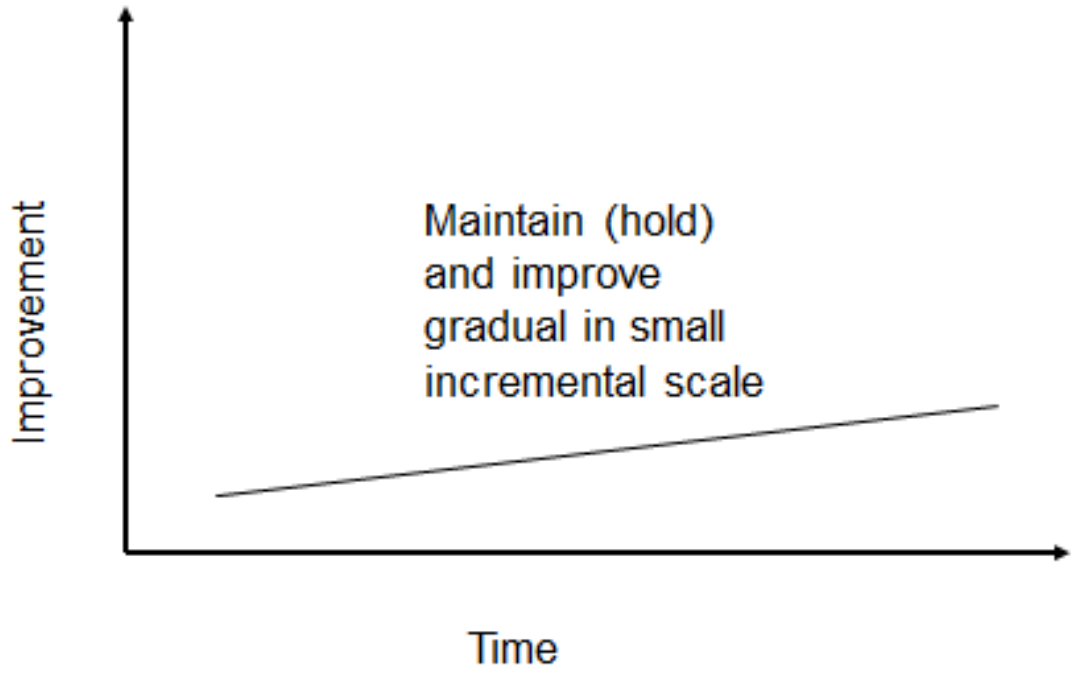
- **Kaizen is a system of continuous improvement** in quality, technology, processes, company culture, productivity, safety and leadership. Kaizen was created in Japan following World War II. The word Kaizen means "continuous improvement". It comes from the Japanese words 改 ("kai") which means "change" or "to correct" and 善 ("zen") which means "good".
- **Kaizen is a system that involves every employee** - from upper management to the cleaning crew. Everyone is encouraged to come up with small improvement suggestions on a regular basis. This is not a once a month or once a year activity. It is continuous.
- **Kaizen is based on making little changes on a regular basis**: always improving productivity, safety and effectiveness while reducing waste.
- **Kaizen is based on making changes anywhere** that improvements can be made.

What is Kaizen?

- Western philosophy may be summarized as, "if it ain't broke, don't fix it." The **Kaizen philosophy is to "do it better, make it better, improve it even if it isn't broken**, because if we don't, we can't compete with those who do."
- Kaizen in Japan is a system of improvement that includes both home and business life.
- In business Kaizen encompasses many of the components of Japanese businesses that have been seen as a part of their success. **Quality circles, automation, suggestion systems, just-in-time delivery, Kanban and 5S are all included within the Kaizen system** of running a business.
- Kaizen involves setting standards and then continually improving those standards. To support the higher standards Kaizen also involves providing the training, materials and supervision that is needed for employees to achieve the higher standards and maintain their ability to meet those standards on an on-going basis.

Kaizen for Improvement

- Continuous Improvement activities over time. Such improvements are usually small and incremental in scope.
- Common approach to Improvement in Japanese organizations

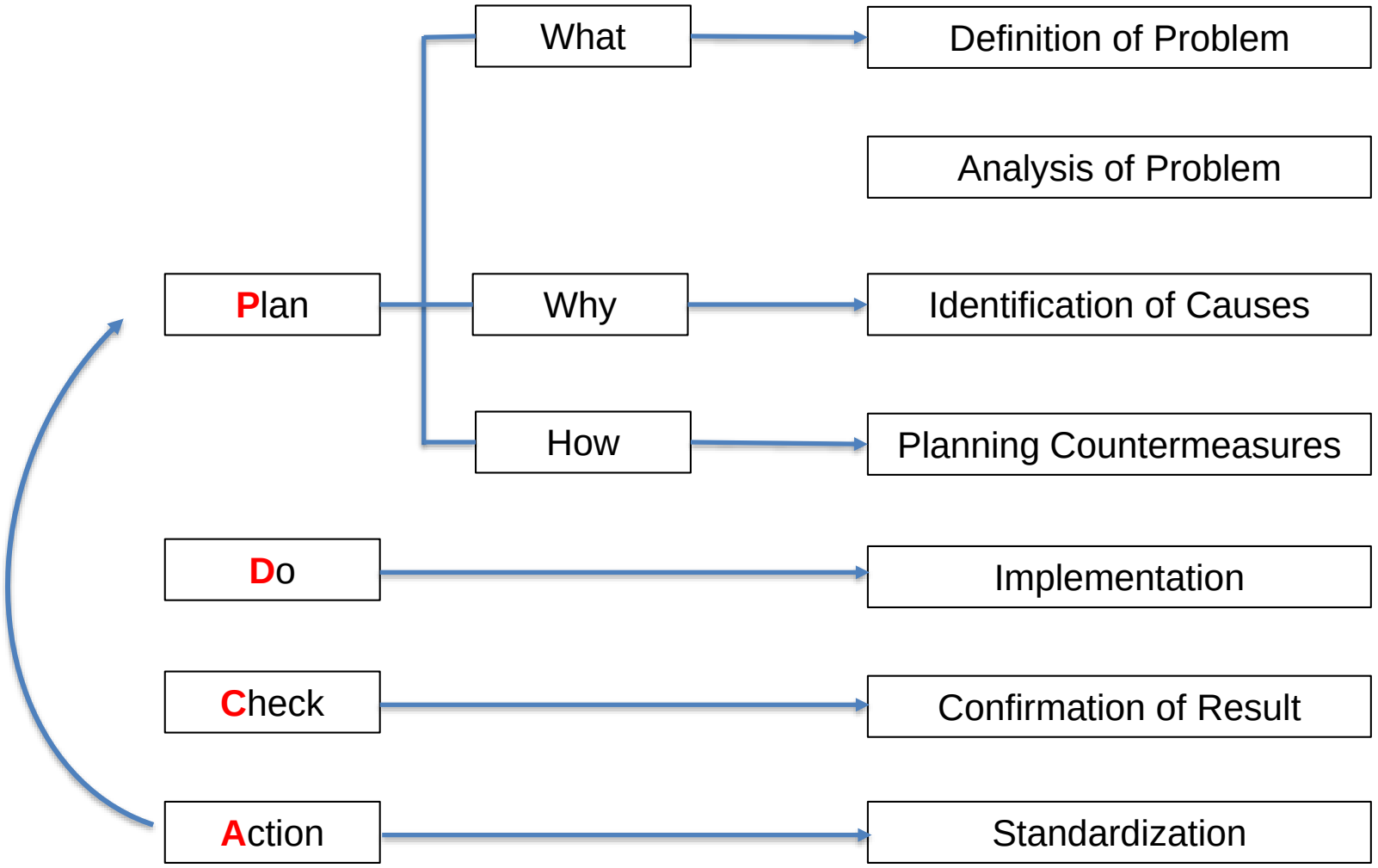


kai **zen**

改 善

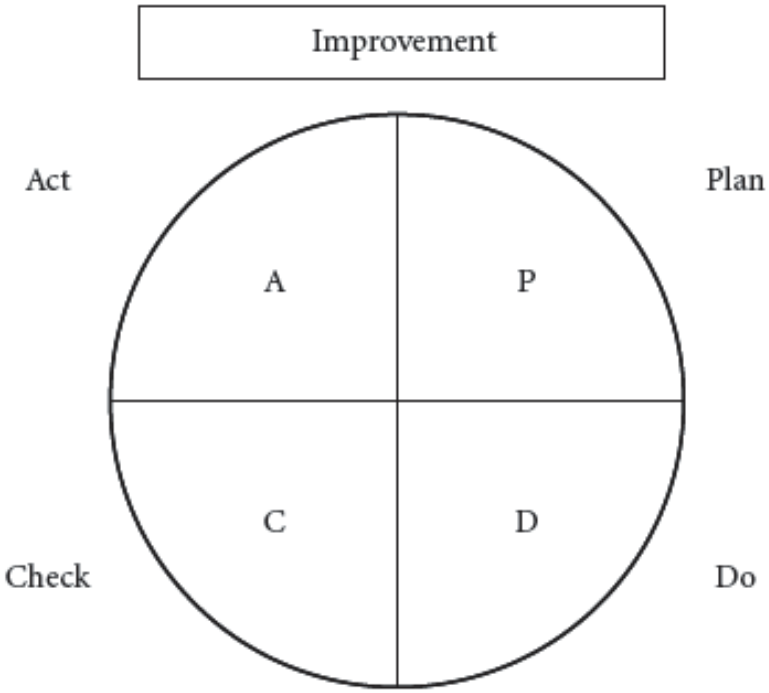
change **good**

One Approach to Kaizen - PDCA



Plan-Do-Check-Act (PDCA)

- Plan refers to establishing a target for improvement (since kaizen is a way of life, there always should be a target for improvement in any area) and devising action plans to achieve that target.
- Do refers to implementing the plan.



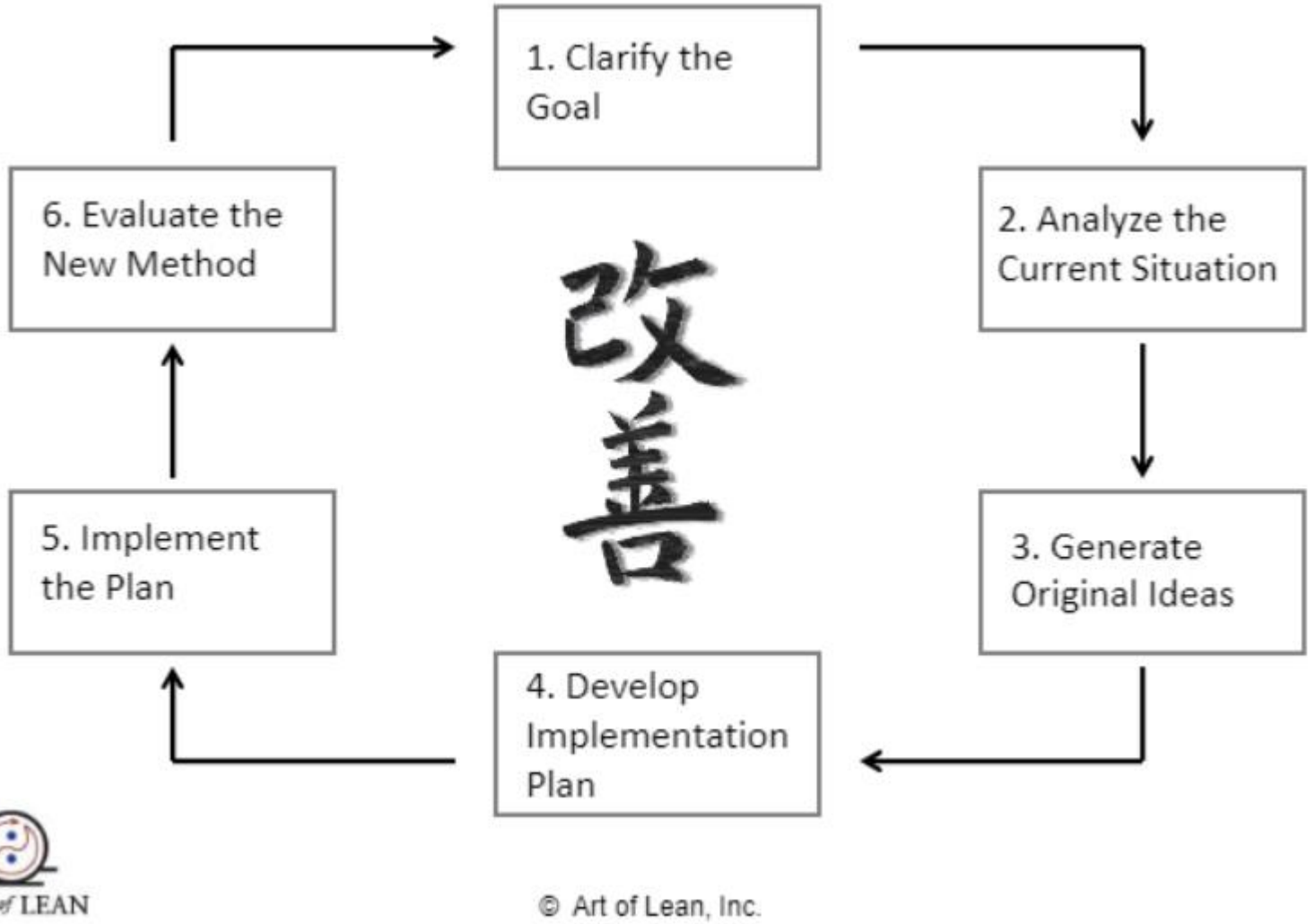
The plan-do-check-act (PDCA) cycle.

- Check refers to determining whether the implementation remains on track and has brought about the planned improvement.
- Act refers to performing and standardizing the new procedures to prevent recurrence of the original problem or to set goals for the new improvements.

Toyota approach: Six Steps of Kaizen

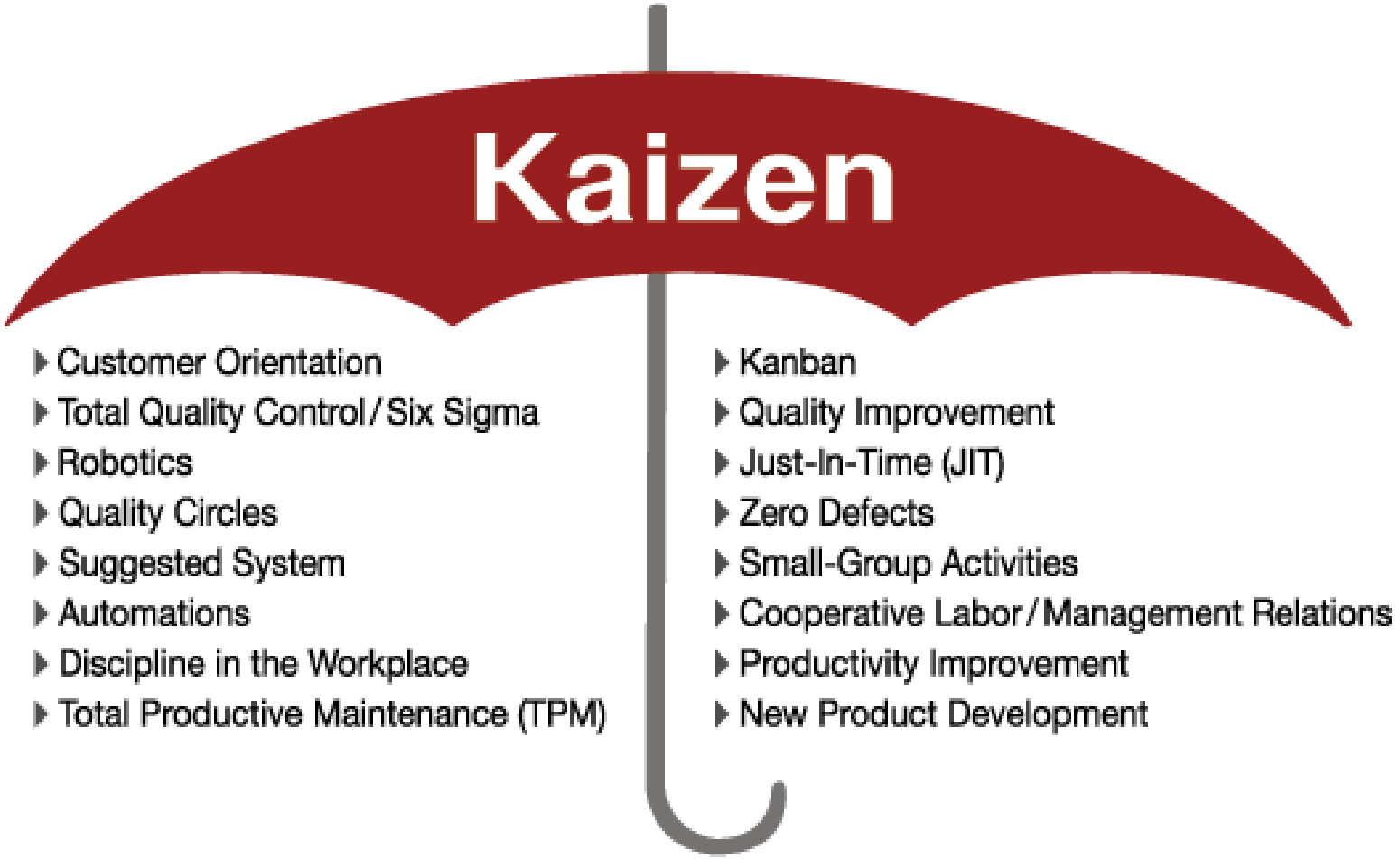
Source: Toyota Kaizen Methods : Six Steps to Improvement, ISBN:978-1-4398-3853-2, 2011

Toyota approach: Six Steps of Kaizen



Source: Toyota Kaizen Patterns & Basic Stability, https://businessdocbox.com/Logistics/70799069-Toyota-kaizen-patterns-basic-stability.html

Common tools used by Kaizen



Source: Toyota Kaizen Patterns & Basic Stability, https://businessdocbox.com/Logistics/70799069-Toyota-kaizen-patterns-basic-stability.html

Typical Kaizen Timeline

Typical Kaizen Timeline

Duration	*Preevent Planning 1–2 Weeks*	*Kaizen Event 1 Week*	*Event Follow-Up 3–4 Weeks*
Description	Complete Define phase: 1. Develop and refine project charter. 2. Identify participants. 3. Define roles and responsibilities. 4. Develop process map (if possible). 5. Collect and chart data.	Complete Measure, Analyze, and Improve phases; develop control plans: 1. Refine or develop process map. 2. Gather and analyze data. 3. Brainstorm and select solutions. 4. Perform pilot tests. 5. Develop/revise process documentation that describes new standards. 6. Develop plans to sustain the change.	Complete implementation and control: 1. Implement final changes. 2. Make final changes to documentation and training. 3. Hand off control to process owner(s). 4. Validate results at a future date.

Source: The Lean Six Sigma Guide to Doing More With Less: Cut Costs, Reduce Waste ...By Mark O. George

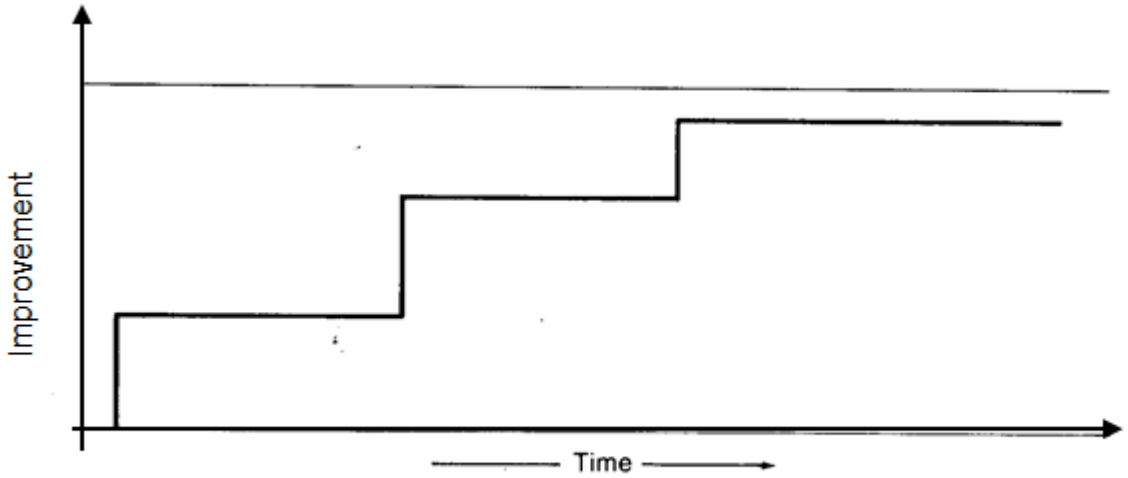
Three key types of participants in a Kaizen

Three key types of participants in a Kaizen:

1. Project Sponsor: the manager who has authority over the work area where the event will take place
2. Event Facilitator: responsible for preparation and final results, managing the agenda during the event
3. Team Member: people who work with process everyday, plus “outside” experts

Innovation for improvement

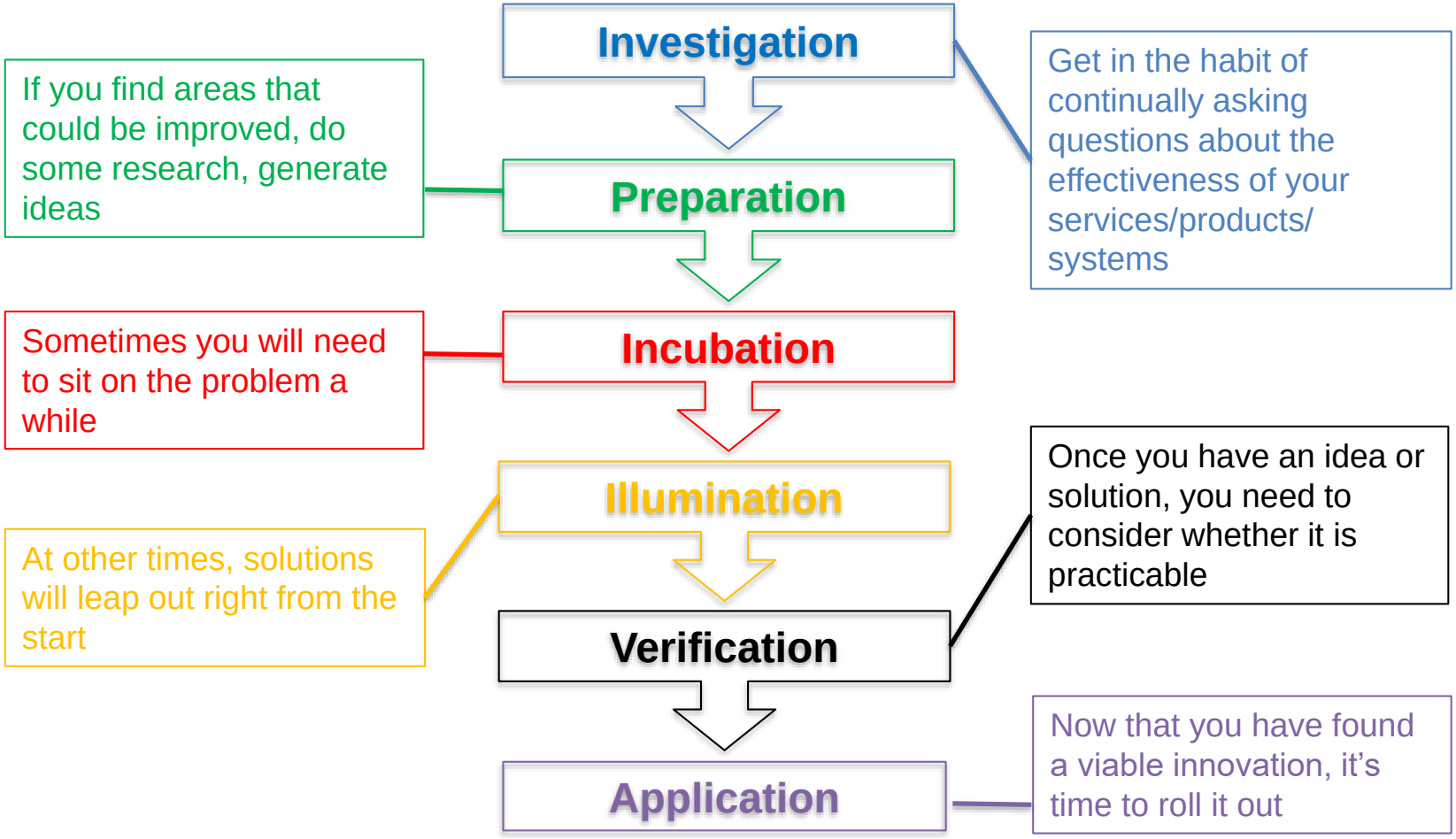
- Improvement is done on a dramatic scale where breakthrough and major improvement is expected.
- Advanced technologies are applied



Ideal pattern - Innovation

How Innovation happens?

Innovation – A systematic approach



Source: http://www.innovationexchange.net/system/files/u47/nfp_innovation_process.jpg

Examples of Innovation in History

1. Cars

Petrol/Diesel car

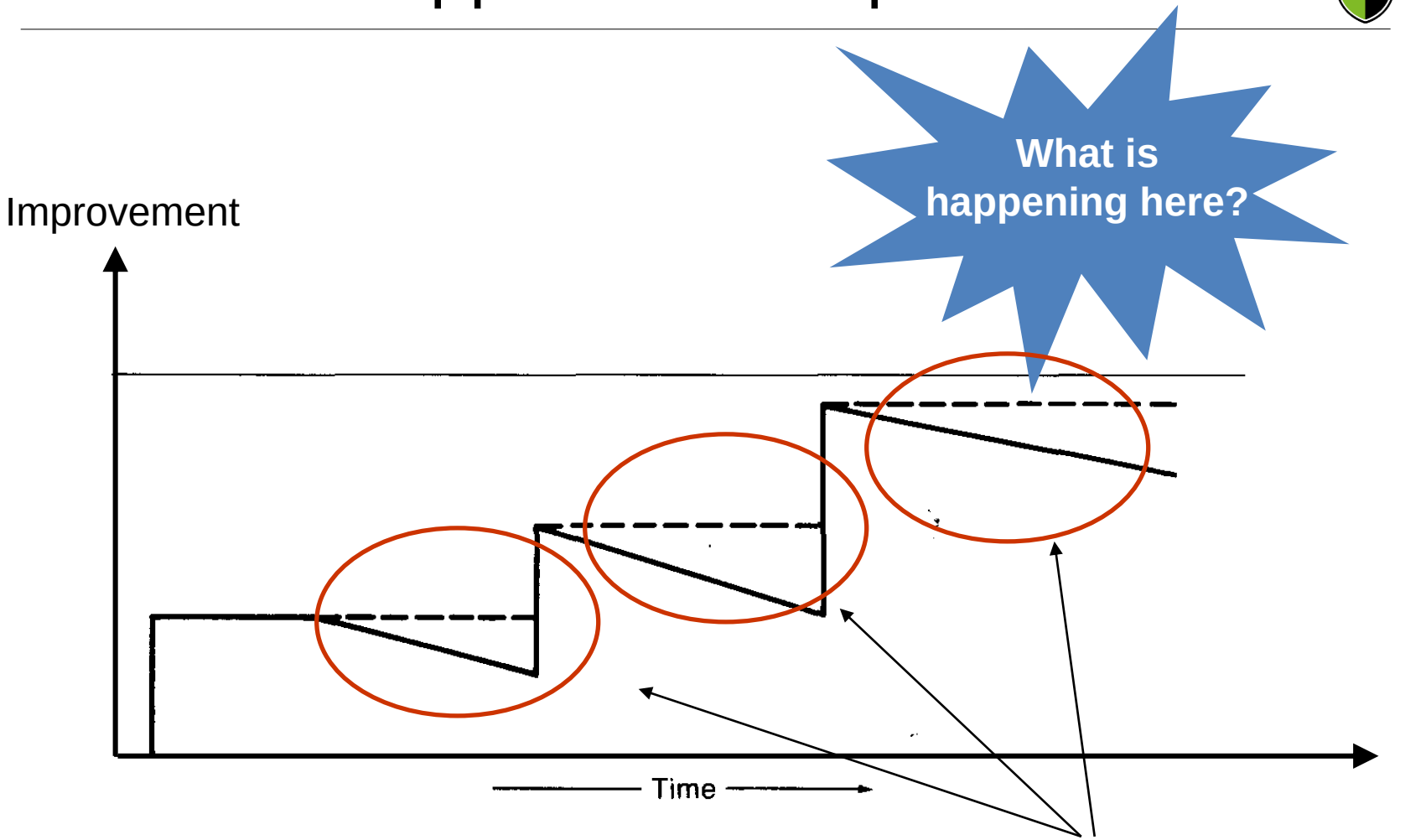
Electric car

2. Hotels

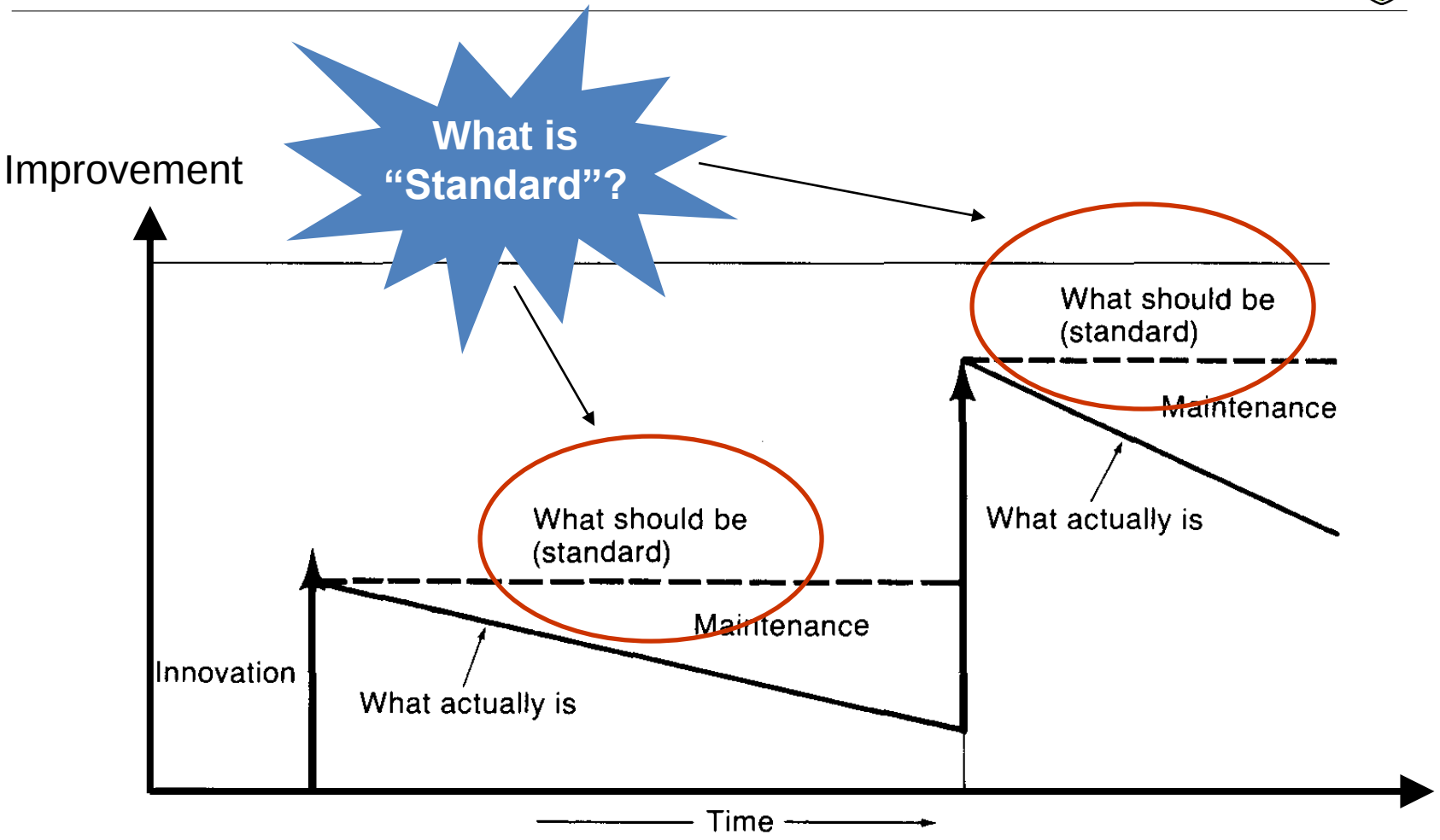
Hotel/Motel

airbnb

Innovation Approach to Improvement

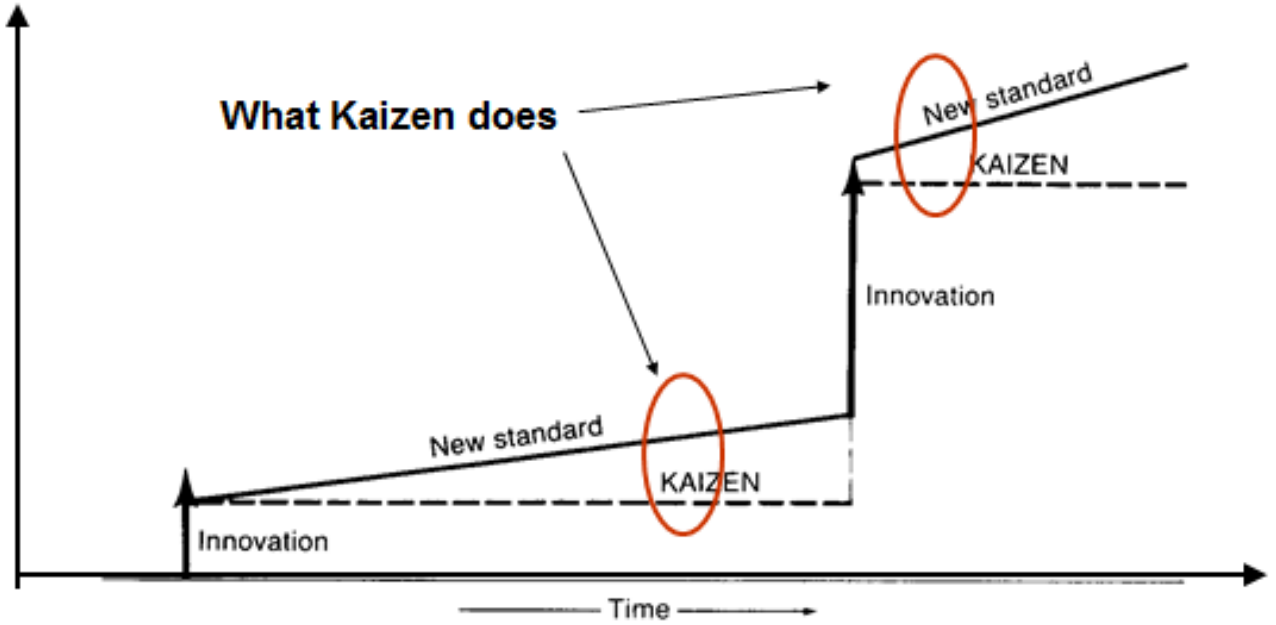


Innovation Approach to Improvement



Actual pattern from Innovation

Kaizen + Innovation to Improvement



Kaizen is to :

1. Standardize the improvement (from Innovation and even Kaizen itself)
2. Maintain the gain
3. Carry out gradual and incremental improvement

Kaizen versus Innovation

	KAIZEN = CONTINUOUS IMPROVEMENT	INNOVATION
1. Effect	Long term and long lasting but undramatic	Short term but dramatic
2. Pace	Small steps	Big Steps
3. Timeframe	Continuous and incremental	Intermittent and non-incremental
4. Change	Gradual and constant	Abrupt and volatile
5. Involvement	Everybody	Select few “champions”
6. Approach	Collectivism, group efforts, systems approach	Rugged individualism, individual ideas and efforts
7. Mode	Maintenance and improvement	Scrap and rebuild
8. Spark	Conventional know-how and state of the art	Technological breakthrough, new inventions, new theories
9. Practical requirements	Requires little investment but great effort to maintain it	Requires large investment but little effort to maintain it.
10. Effort orientation	People	Technology
11. Evaluation criteria	Process and efforts for better results	Results for profit
12. Advantage	Works well in slow growth economies	Better suited to fast growth economy

Class activity - Plug Game of Lean

- **Objective:**
  - Assemble as many plugs as possible;
  - Plugs assembled should follow the sample plug in every aspect;
  - Assemble the plugs as fast as possible.
- **Where are the problems?**
  - Too messy (both tools and components)
  - Easy to make mistakes (wrong components, wrong installation)
  - Not fast enough (workers' efforts are neither coordinated nor organized)
- **Possible solutions:**
  - "5 Whys" to get to the root causes
  - 5S to get everything sorted out
  - Poka Yoke for error proofing
  - VSM to map out the work and design a workflow (a balanced assembly line)
  - Line Balance, One piece flow, Standardised Work, Importance of team working
- **Discussions:**
  - The process to come out with the solutions and achieve the results is important here. (Plan, Do, Check, Action)
  - You may wish to identify & solve all the problems in one shot! However, is it possible? "Rome wasn't built in a day", let's aim for continuous improvements.

Proposed solution (for the plug exercise)

http://www.youtube.com/watch?v=l0Mxn2MutjE

Example of lessons learned :

- Round 1: Isolated station -> Batch production. C/T too slow. Customer did not receive any part
- Round 2: Stations arranged side-by-side. 2 guys in the 1st station to improve the productivity with a batch size of 5 -> some improvement in C/T
- Round 3: Batch size reduced to 1. Single piece flow of parts through the process -> bottleneck still occurs
- Future rounds: 5S, Kanban*. Sort, Set in order and Standardize the arrangement of components/sitting arrangement -> Drastic improvement in C/T and better quality products

Note (*): Kanban is not an inventory control system but rather a scheduling system that helps determine what to produce, when to produce it, and how much to produce.

Typical improvements (for the plug exercise)

Plug simulation game :

	Round 1	Round 3
Lead time	600 seconds	53 seconds
Work in progress	36 plugs	6 plugs
Rejects	15 plugs	None
Good plugs accepted	None	40

Problem 11
Suggested Solution

Problem Statement – What we know…

Few weeks had past and the team witnessed that the situation was not getting any better…

[3] Smart Tray Return Robots'

Option B: To follow suit in latest-in-class technologies like 'Smart Tray Return Robots'

[2] 'Tray Return Initiatives'

Option C: Implement incremental and continuous improvements

[1] 'Eat-and-Leave' culture

Option A: To switch back to rely on more cleaners.

Problem Statement – What we do not know…

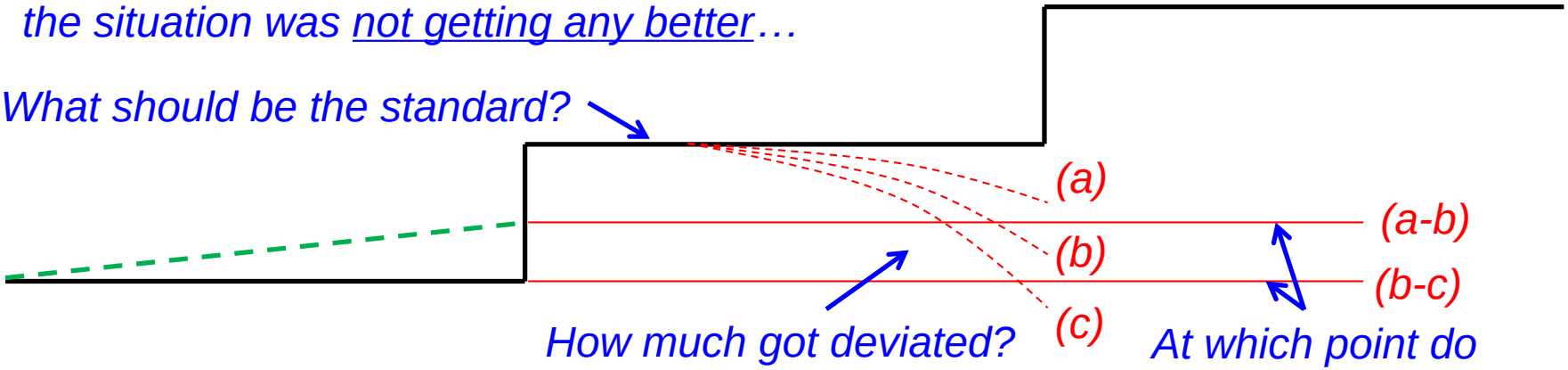
[1]‘Eat-and-Leave’ culture

[2] ‘Tray Return Initiatives’

[3] Smart Tray Return Robots’

Few weeks had past and the team witnessed that the situation was not getting any better…

What should be the standard?



What are the incremental improvements, at [1]?

Importantly: What are the reasons for the drop?

Option A: To switch back to rely on more cleaners.

Option C: Implement incremental and continuous improvements

Option B: To follow suit in latest-in-class technologies like ‘Smart Tray Return Robots’

Problem Statement – What we need to find out…

[1]‘Eat-and-Leave’ culture

[2] ‘Tray Return Initiatives’

[3] Smart Tray Return Robots’

Are there possibly incremental and continuous improvements at [2]?

What standard to expect of [3]?

What are the challenges to maintain at this standard?

What are the incremental improvements, at [1]?

Importantly: What are the reasons for the drop?

Option A: To switch back to rely on more cleaners.

Option C: Implement incremental and continuous improvements

Option B: To follow suit in latest-in-class technologies like ‘Smart Tray Return Robots’

Proposed solution
(ability to distinguish innovations from Kaizen)

Automation, staff training win Koufu a productivity award

Jacqueline Woo

Automation and technology have been key drivers in raising productivity for food centre operator Koufu over the past seven years.

The group, which runs more than 80 outlets here, halved its food preparation time by automating the production of steamed buns and siew mai at its central kitchens, for instance.

More importantly, it also focuses on skill development, allocating 1 per cent of its total revenue to training and development so there is continuous learning for employees at all levels, including the management.

Koufu's efforts in productivity clinched the group an award of excellence in the food and beverage sector at the Singapore Productivity Awards ceremony yesterday.

"Despite the many competing demands, the company has consciously allocated time and resources to train its employees through regular in-house workshops and external training sessions to improve employees' decision-making and financial skills, as well as their customer service standards," said Minister for Trade and Industry (Industry) S. Iswaran at the event.

"I understand that Koufu's founders... go to the ground to personally share their experiences with their line managers and ground staff during in-house training programmes, which their employees appreciate greatly. Koufu's example clearly shows the benefits of investing in skill development, and that it need not be difficult to execute, even in today's challenging economic environment."

Mr Iswaran acknowledged that, structurally, Singapore has entered a new mode of growth: "Domestic constraints and demographic trends restrict the capacity to grow our labour force. Therefore, productivity growth remains our primary means of achieving sustainable economic growth."

Koufu piloted three Smart Tray Return Robots at its foodcourt in Punggol Plaza. The robots have sensors that help them to navigate around tables and encourage patrons to return their trays. The food centre operator was one of 10 companies honoured at the Singapore Productivity Awards yesterday. ST PHOTO: CHEW SENG KIM

The Government launched Industry Transformation Maps in September as part of its Industry Transformation Programme announced in this year's Budget. These lay out the growth and transformation strategies for 23 industries here.

The maps for the food services, retail and precision engineering industries have been released, and more will follow before the end of the year, said Mr Iswaran.

"Productivity will be crucial for Singapore to achieve sustainable growth in the next phase of our economic development. We need the collective effort of all our stakeholders if we are to succeed in transforming our industries to achieve such growth," he added.

Ten companies were honoured at the awards event last night.

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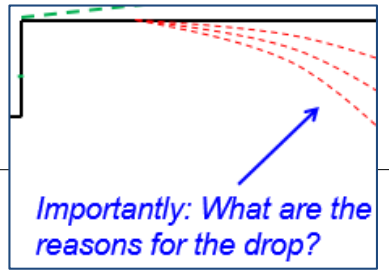
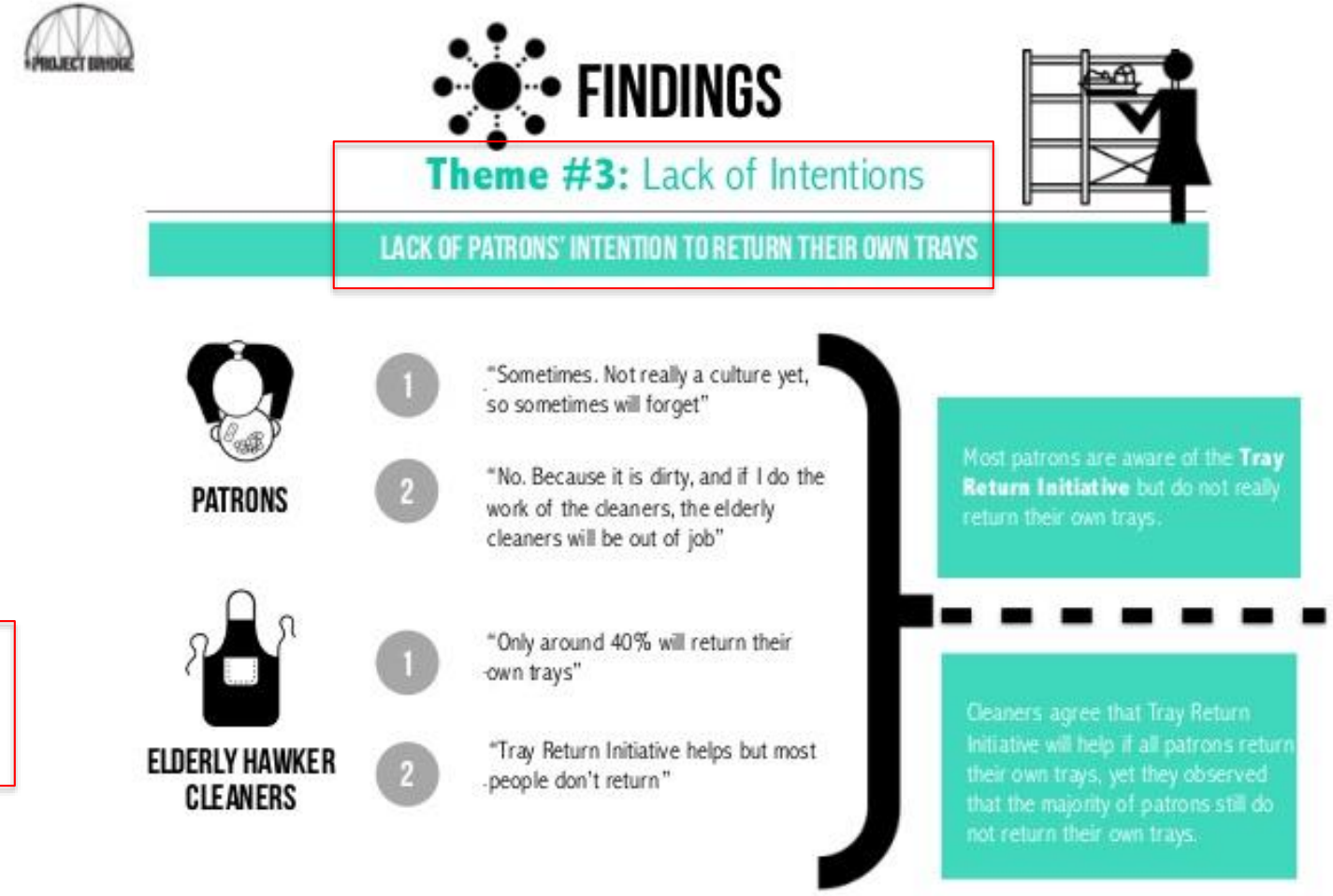
Problem with Tray Return Racks: Insufficient racks, not prominent positioned, packed racks, patrons lack education and awareness, etc.

Kaizen (Continuous Improvements): Increase cleaners, train cleaners, more tray-return racks, educate patrons, more campaigns, reward for returning tray, disposable utensils, etc.

Innovations: 'Smart Tray Return' autonomous robot, conveyor tray return system, 'Self-Cleaning Table', drones, etc.

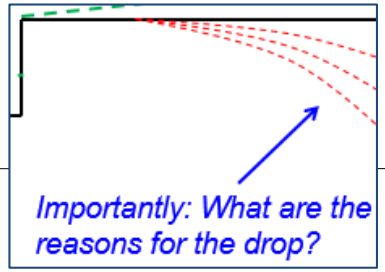
Proposed solution
(understanding what are the reasons for the drop)





"Why should we clear, we are paying."

Proposed solution
(understanding what are the reasons for the drop)



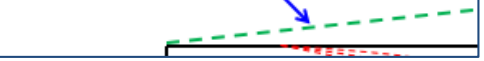
STRUCTURAL

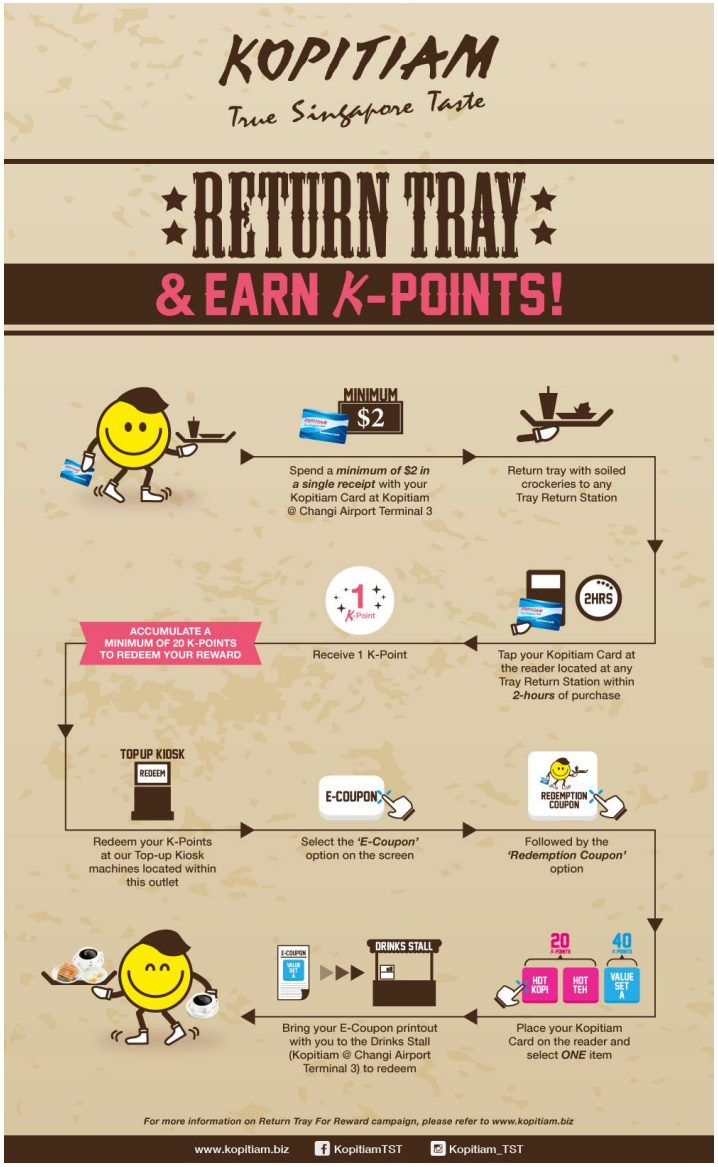
CULTURAL

Proposed solution

(examples of incremental improvements at [2])

Are there possibly incremental and continuous improvements at [2]?





Learning Objectives

- Explain Kaizen – Continuous Improvement in Lean Manufacturing
- Describe the use of “Standard Work” as baseline for Kaizen
- Recognise Innovation approach for improvement and how to apply
- Distinguish between Kaizen Approach and Innovation Approach

Overview of E326 Lean Manufacturing and Six Sigma