2005 亞太風險管理與安全研討會
Asia-Pacific Conference on Risk Management and Safety

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# TOTAL CONSTRUCTIVE MAINTENANCE (TCM): BEYOND LEGISLATIVE CONTROL FOR EQUIPMENT AND MACHINERY

By Davis Liu & Sammy Wan

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# CONTENT



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# CHAPTER 1

# CASE STUDY OF ACCIDENT

## Overview of Accidents arising out of Equipment & Machinery

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# 1. CASE STUDY OF ACCIDENT

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## Sharing of accident cases related to equipment & machinery

- The falling of the **tower crane** at the Kwai Chung construction site on 7 July 2005 that killed the operator.


# 1. CASE STUDY OF ACCIDENT

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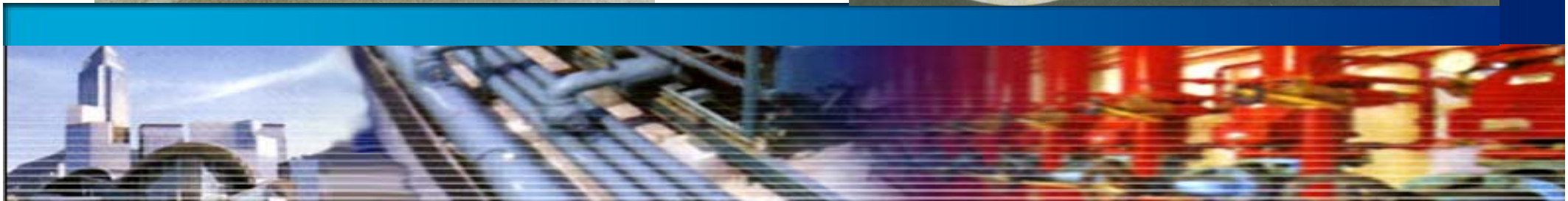
## Sharing of accident cases related to equipment & machinery

- The detachment of the **truck wheel** at the Eastern Corridor on the Hong Kong Island on 6 July 2005 that killed the unprotected victim in the park in the vicinity.

# 1. CASE STUDY OF ACCIDENT

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**Sharing of accident cases related to equipment & machinery**

- If the **material hoist** had been properly maintained, the deceased worker might have been prevented from falling from the landing platform down the hoistway to the ground.

# 1. CASE STUDY OF ACCIDENT

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**Sharing of accident cases related to equipment & machinery**

- If the **site environment** had been properly maintained before and after the typhoon, the deceased worker might have been prevented from being struck by an object falling from the height.

# 1. CASE STUDY OF ACCIDENT

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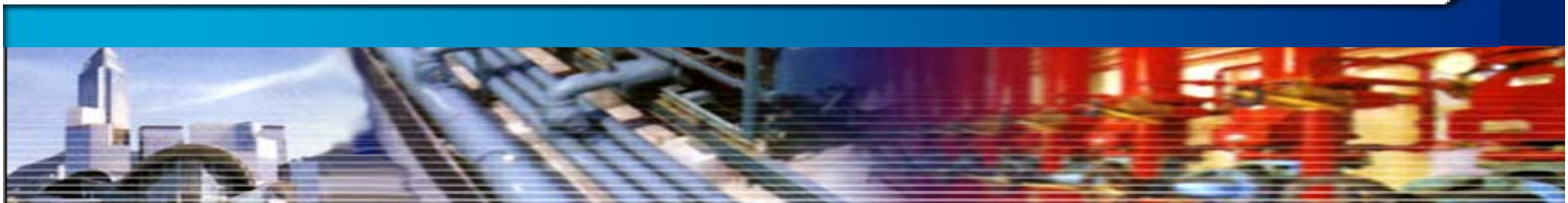
**Sharing of accident cases related to equipment & machinery**

- If the **pressurized piping system** had been properly maintained, the deceased worker might have been prevented from being struck by the metal pipe swinging under pressure.



# 1. CASE STUDY OF ACCIDENT

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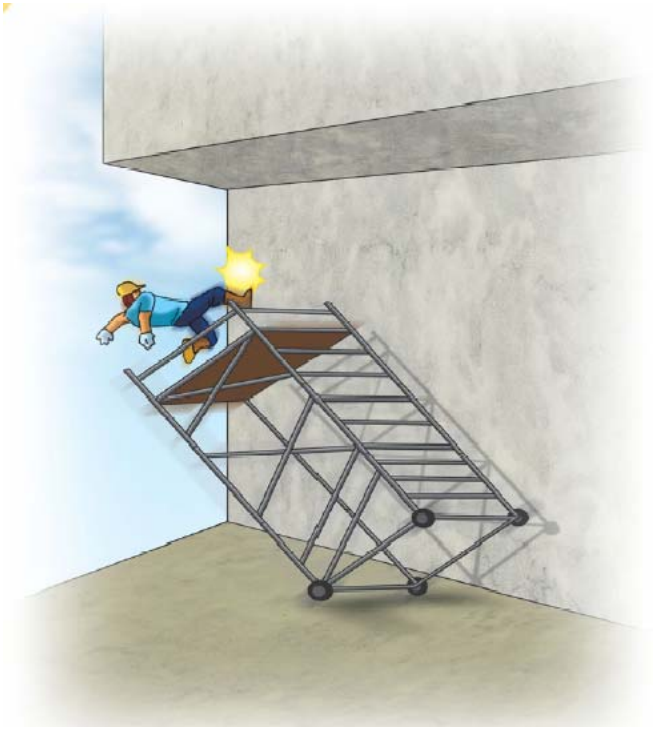
**Sharing of accident cases related to equipment & machinery**

- If the **metal scaffold** had been properly maintained, the deceased cleaning worker might have been prevented from falling with the collapsed scaffold.



# 1. CASE STUDY OF ACCIDENT

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**Sharing of accident cases related to equipment & machinery**

- If the **lighting system** and **bamboo scaffolding system** had been properly maintained, the deceased worker might have been prevented from plunging to death from 13/F of a building under construction in an evening.

# 1. CASE STUDY OF ACCIDENT

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**Sharing of accident cases related to equipment & machinery**

- If the **forklift truck** had been properly maintained, the deceased operator might have been prevented from being hit by the detachable counterweight.

# 1. CASE STUDY OF ACCIDENT

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**Sharing of accident cases related to equipment & machinery**

- If the **falsework** had been properly maintained, the deceased worker might have been prevented from being crushed to death by collapsed structures during concreting work.

# 1. CASE STUDY OF ACCIDENT

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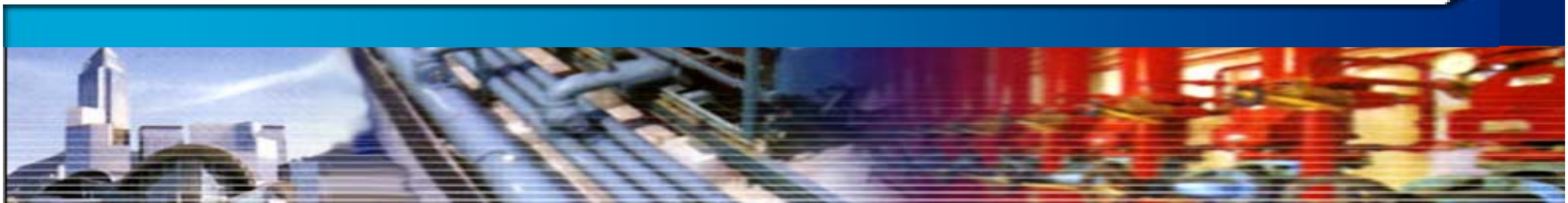
**Sharing of accident cases related to equipment & machinery**

- If the **switch panel** had been properly maintained, the two deceased electricians might have been prevented from the fatal injuries due to flashover.



# 1. CASE STUDY OF ACCIDENT

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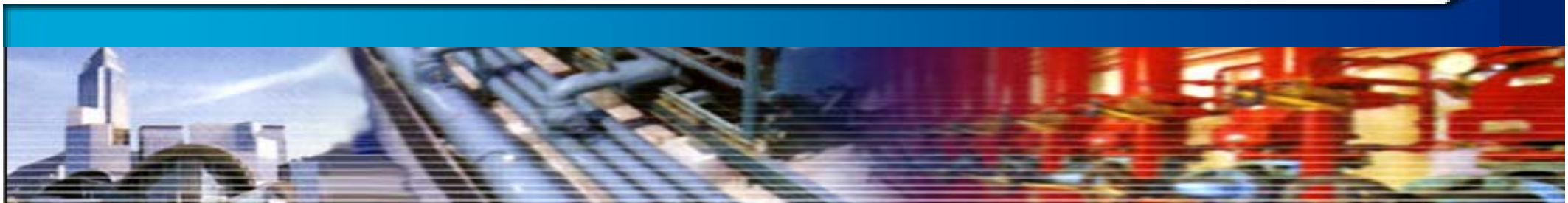
**Sharing of accident cases related to equipment & machinery**

- If the **fluorescent light panel** had been properly maintained, the deceased worker might have been prevented from being electrocuted during fire services maintenance.



# 1. CASE STUDY OF ACCIDENT

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**What lesson can we learn from the cases ?**

Failure of critical components of equipment and machinery can cause large consequential accidents and risk for the personnel at the workplace !!!







# 1. CASE STUDY OF ACCIDENT

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**Sharing of accident cases related to equipment & machinery**

- Judging from the above occupational fatalities, it is easy to conclude that **preventive maintenance** is an effective way to avoid occurrence of industrial accidents.

- The implementation of this programme is valuable to:

  a) address **dangerous** conditions and behaviour,

  b) eliminate any minor and critical **defects** of equipment and machinery,

  c) change the **wrong perception** of operations.

- It is certain that the **persevering efforts** made in upholding the programme will prove to be useful in avoiding accidents and will not be in vain.

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CHAPTER 2

# PHILOSOPHY OF TPM

**Useful approach to maintain equipment and machinery on site**

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# 2. PHILOSOPHY OF TPM

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## Basic concept

- TPM is both a philosophy and a collection of practices and technique which is widely adopted in the Japanese industry.

- TPM is built on the **preventive maintenance approach** which involves performing routine inspections and servicing and keeping facilities in good repair.

- It is helpful to:

  a) optimize the reliability and effectiveness,

  b) maintain the integrity,

  c) eliminate the accidents, defects, breakdowns and the associated losses.

# 2. PHILOSOPHY OF TPM

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## Basic concept

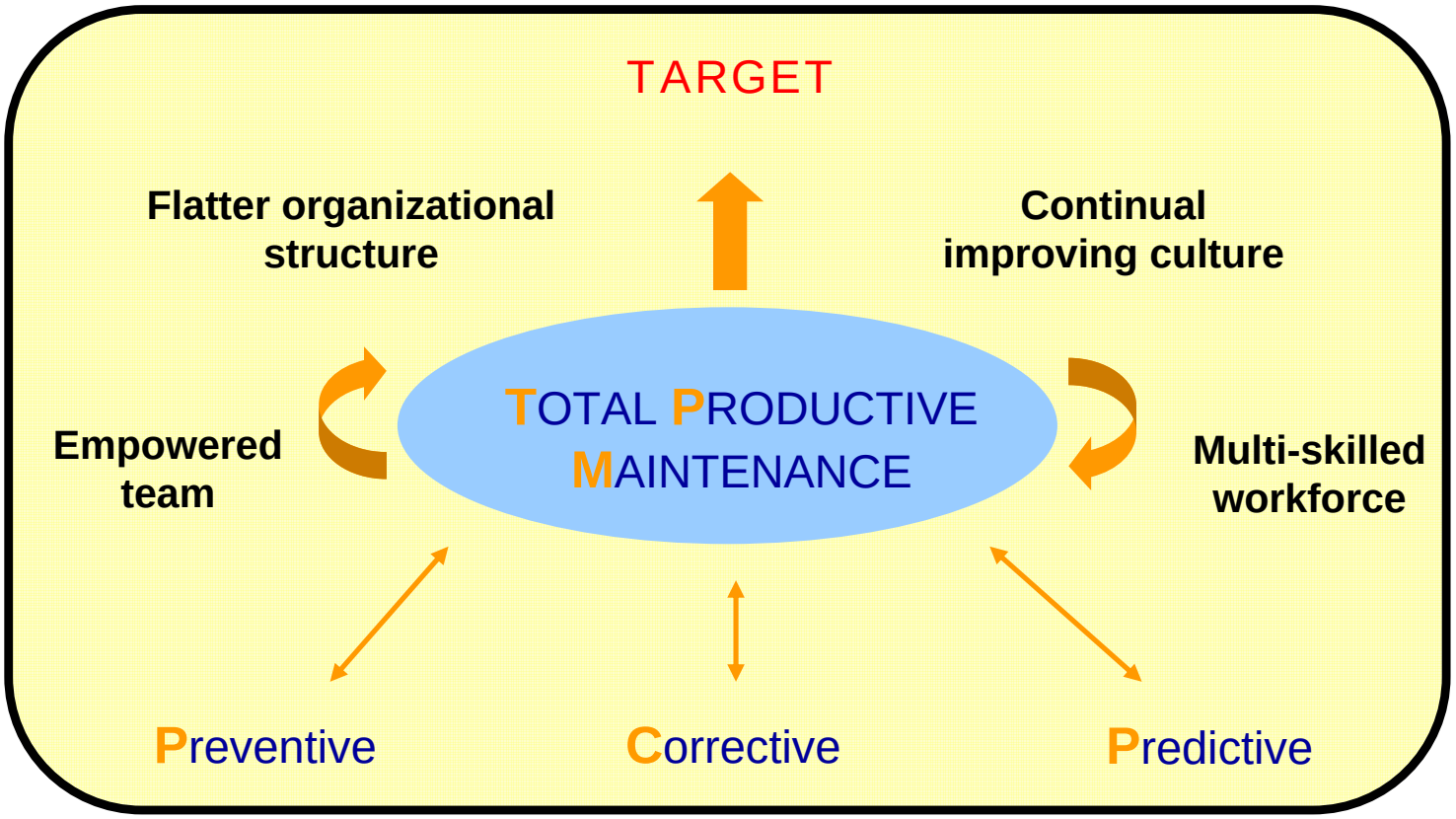
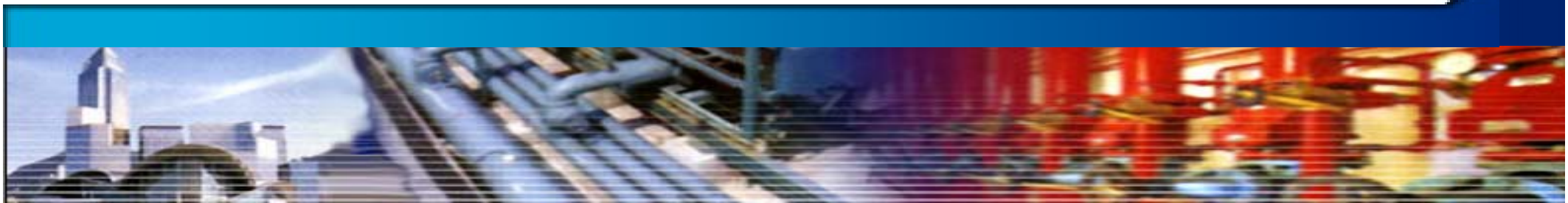



*Fig. 1 Conceptual view of total productive maintenance*



# 2. PHILOSOPHY OF TPM

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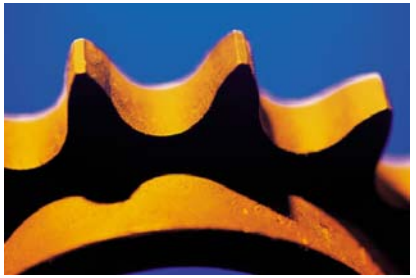
## Advantages of TPM

- TPM uses the **combined skills** to restore deteriorating equipment, maintain basic equipment and operating standards, improve design weaknesses and prevent human errors.

- Many **potential failures** and **minor defects** are completely identified and eliminated and this results in the elimination of accidents arising out of the minor defects.

- Full **involvement** of all levels and functions of employees may enhance the maintenance standard and advance the equipment performance.



# 2. PHILOSOPHY OF TPM

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## Advantages of TPM

- The operators will now have a greater **responsibility** and **authority** for maintaining the equipment and a responsible attitude to report the condition and availability of the equipment

- The **culture** of continuous machinery improvement is developed and all employees can acquire new knowledge and skills regarding equipment care for achieving optimal equipment condition and human performance.

# 2. PHILOSOPHY OF TPM

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## Advantages of TPM

- This will end up with the improvement of productivity and the **unproductive costs** arising out of accidents will be eliminated as a return investment for equipment or technological upgrading and good practice development.

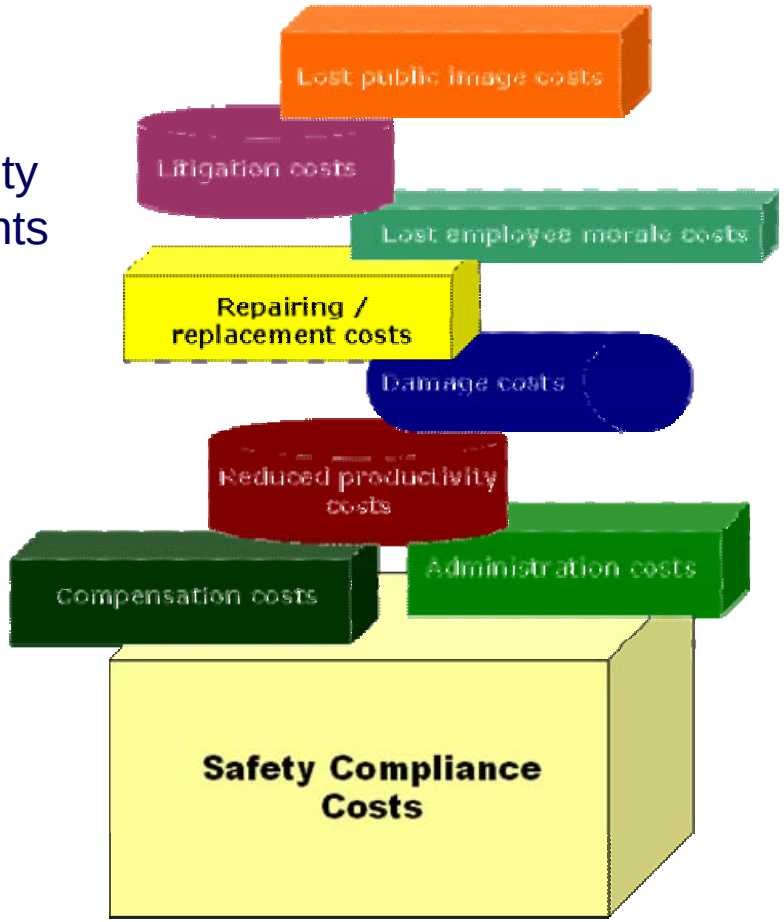
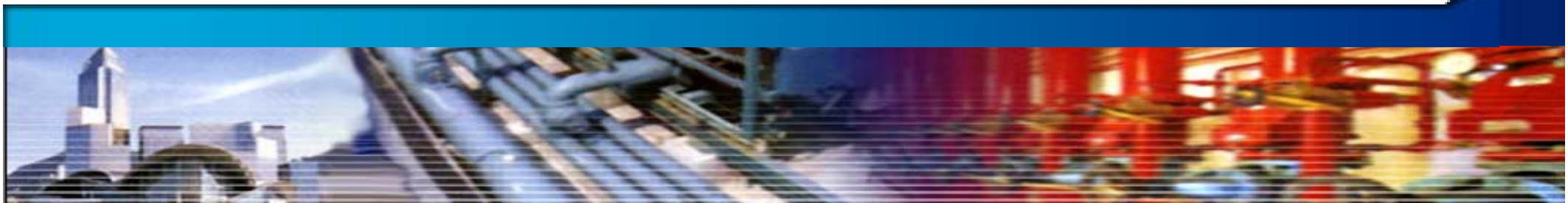



*Fig. 2* *Full safety costs borne by participants in the industry*



CHAPTER 3

# ACHIEVEMENT OF TPM

## Features for improving safety standards

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# 3. ACHIEVEMENT OF TPM

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## Identification & investigation of minor faults

- Any **minor faults** are identified and eliminated while the deterioration is prevented from the equipment and machinery in the construction site.

- Causes of the faults are investigated systematically and this is crucial for further equipment **upgrading** and **improvement**.

# 3. ACHIEVEMENT OF TPM

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## Tidiness & cleanliness of machinery & equipment

- Clean, tidy and neat **work environment** is maintained which is in line with the popular 5S housekeeping programme for the construction sites.

- All equipment and machinery are maintained in a **good condition** and the components and protective guards provided are equipped and maintained properly.

# 3. ACHIEVEMENT OF TPM

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## New knowledge & skills for equipment care

- All staff members can acquire **new knowledge** and **skills** regarding equipment care in order to achieve optimal and safe equipment conditions.

- It is valuable for the promotion of the **safe working cycle** which works at the same pace of the TPM programme.

# 3. ACHIEVEMENT OF TPM

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## Monitoring & improving of effectiveness & performance

- Personnel at all levels and functions such as operators, technicians, supervisors, etc are involved as **daily job routine** to provide support to the maintenance activities and the work methods will be optimized and continuously improving with new safety features.

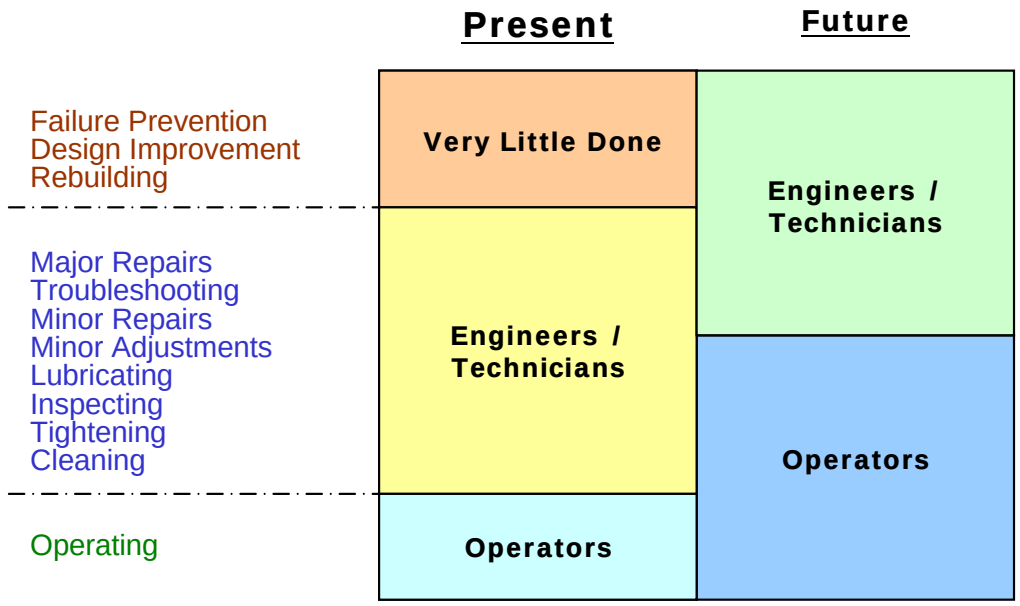
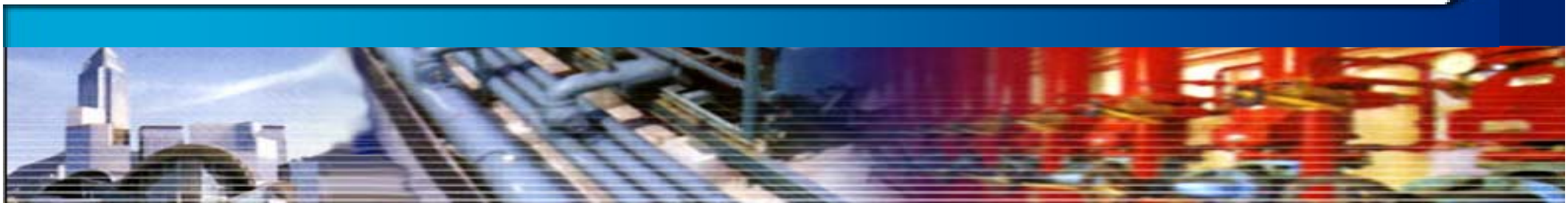



*Fig. 3* *Elevation of human skills through the TPM*



# 3. ACHIEVEMENT OF TPM

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## Self-governing & shared management

- A new style of management focusing on participation and continuous improvement is cultivated and is useful for developing a **self-regulating attitude**.

- A **shared ownership** within the workplace is built on a self-governing and independent basis. .

# 3. ACHIEVEMENT OF TPM

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## Monitoring & improving of effectiveness & performance

- Effective **two-way communication** channels are built for all levels and functions of staff members to enhance the cooperation and reduce the confrontation.

- A **favourable environment** will be developed for continuously improving the safety standards, product quality and work performance.

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CHAPTER 4

# GETTING LEAN BY TCM

## The use of total constructive maintenance for future lean construction

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# 4. GETTING LEAN BY TCM

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## Developing Total Constructive Maintenance (TCM) culture

- In line with the spirit of the self-governing regulations of the F&IU (Safety Management) Regulation, TPM philosophy can further be developed into TCM.
- Staff members at all levels will now spend less time on simple and unskilled tasks but spend more time on **preventing breakdowns** of every construction process.
- Cooperative effort creates **job enrichment** and **pride** and this will help maintain a closer working relationship and higher morale and eventually promote partnering.

# 4. GETTING LEAN BY TCM

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## Developing Total Constructive Maintenance (TCM) culture

- Costs involved in **unscheduled breakdowns** of construction processes not only be extremely high but trigger potential unsafe work environment for production.
- TCM emphasizes **life-cycle costing** because the reliability and maintainability will also be considered systematically over the life cycle.
- TCM culture strives for improving the effectiveness of both operations and maintenance and ultimately, extends to the **entire supply chain network** of the industry.

# 4. GETTING LEAN BY TCM

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## Preparation for lean construction

- The lean construction concept is influential in optimizing the performance of construction activities and identifying and eliminating **unwanted wastes or frictions** in every process.
- TCM process can greatly reduce **unwanted breakdowns** and **changeover time** of work processes in order to achieve a dual goal of zero breakdowns as well as zero defects.
- Efficient, clean and tidy work environment is maintained with **good team spirit** and **morale** conducive to a favourable environment for lean production.

# 4. GETTING LEAN BY TCM

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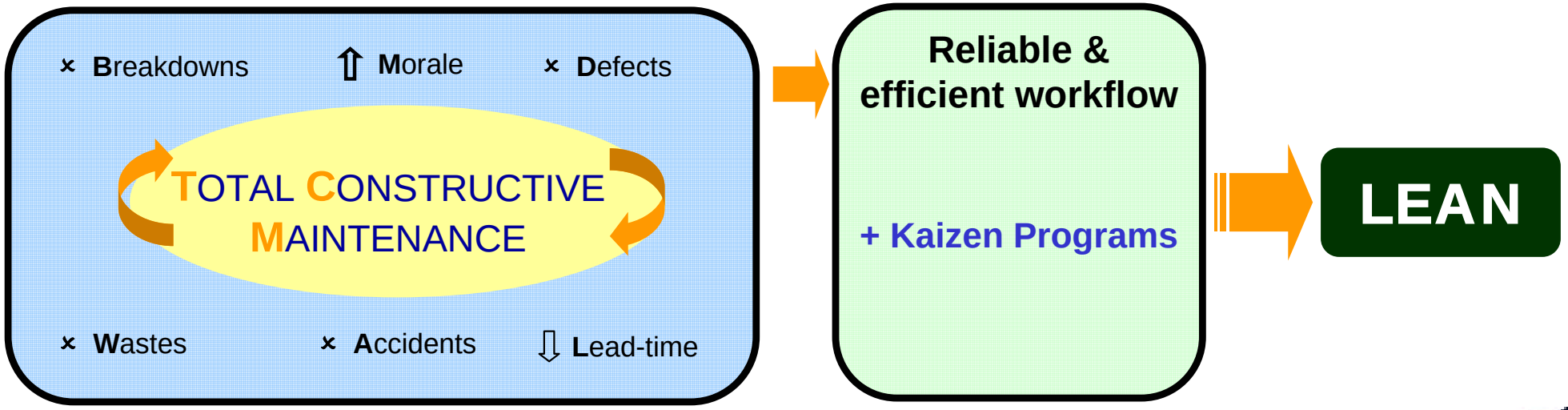
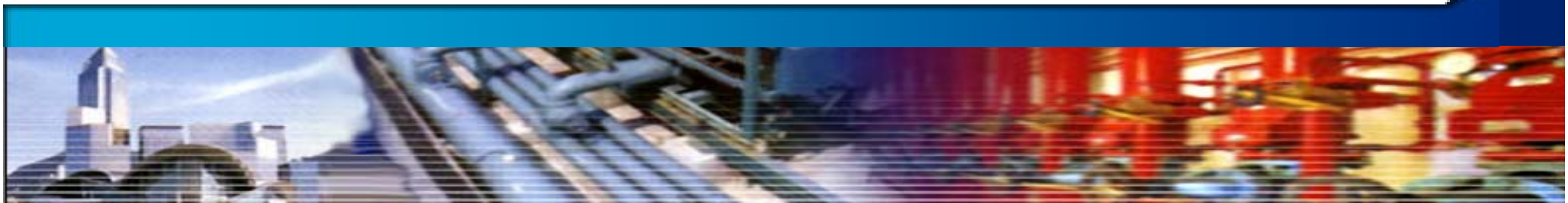
## Preparation for lean construction

- Under the off-site manufacturing of in-process products, it becomes easier to apply lean production techniques as well as different **kaizen improvement programmes**.
- Difficulty obstructing lean construction is the degree of **commitment**.



# CHAPTER 5

# CONCLUSION

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# 5. CONCLUSION

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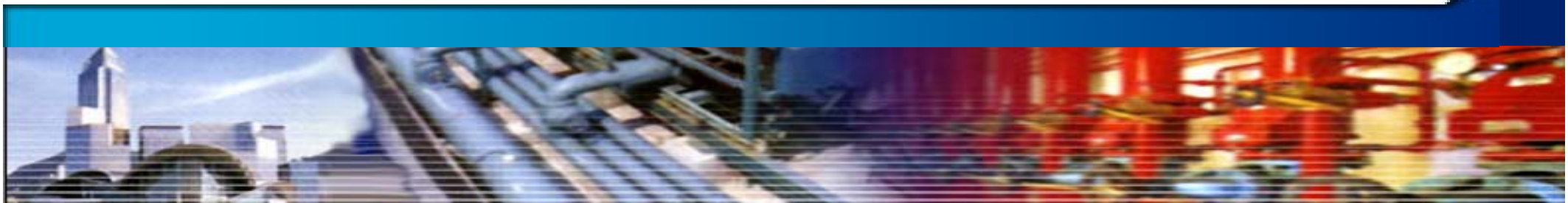
## Preparation for lean construction

- Legislation can hardly create a **self-governing culture** within enterprises.
- TPM has many advantages to **reduce accidents** related to machinery and equipment.
- TCM can further be developed to achieve ultimate goal of **zero accident** and seek for **continual improvement** of construction processes.
- TCM ends up with **reliable** and **efficient workflow** and create opportunities for lean construction.



# THANK YOU

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