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# **BIG DATA IN LEAN SIX-SIGMA: CASE STUDY OF MAINTENANCE PREVENTIVE PACKAGE OPTIMIZATION**

**Abdulaziz A. Bubshait,**

**Abdullah Al-Shehri**

King Fahd University of Petroleum & Minerals

# Outline



- The use of Big Data in maintenance
- What is this research about?
- What is Big Date?
- How can Big Date Analysis help the firms?
- Data Mining Techniques
- The use of BD in six sigma
- Case study
- Conclusion

# Introduction

The use of Big Data in maintenance is holding many promises



- Streamline maintenance operation,
- Cut cost, and
- Enhance equipment availability.

# Objective



- To explore how Big Data can bring new light and innovation to six-sigma projects.
- A case study regarding improvement of maintenance work duration using lean Six Sigma is presented

# What is BD?

Big data is referred to the large data sets that are often challenging to examine and investigate due to their complexity and variability.



# How can BDA help the firms?

It will unveil the hidden patterns, market trends, customer preferences, unknown causality and correlations between the different parameters.



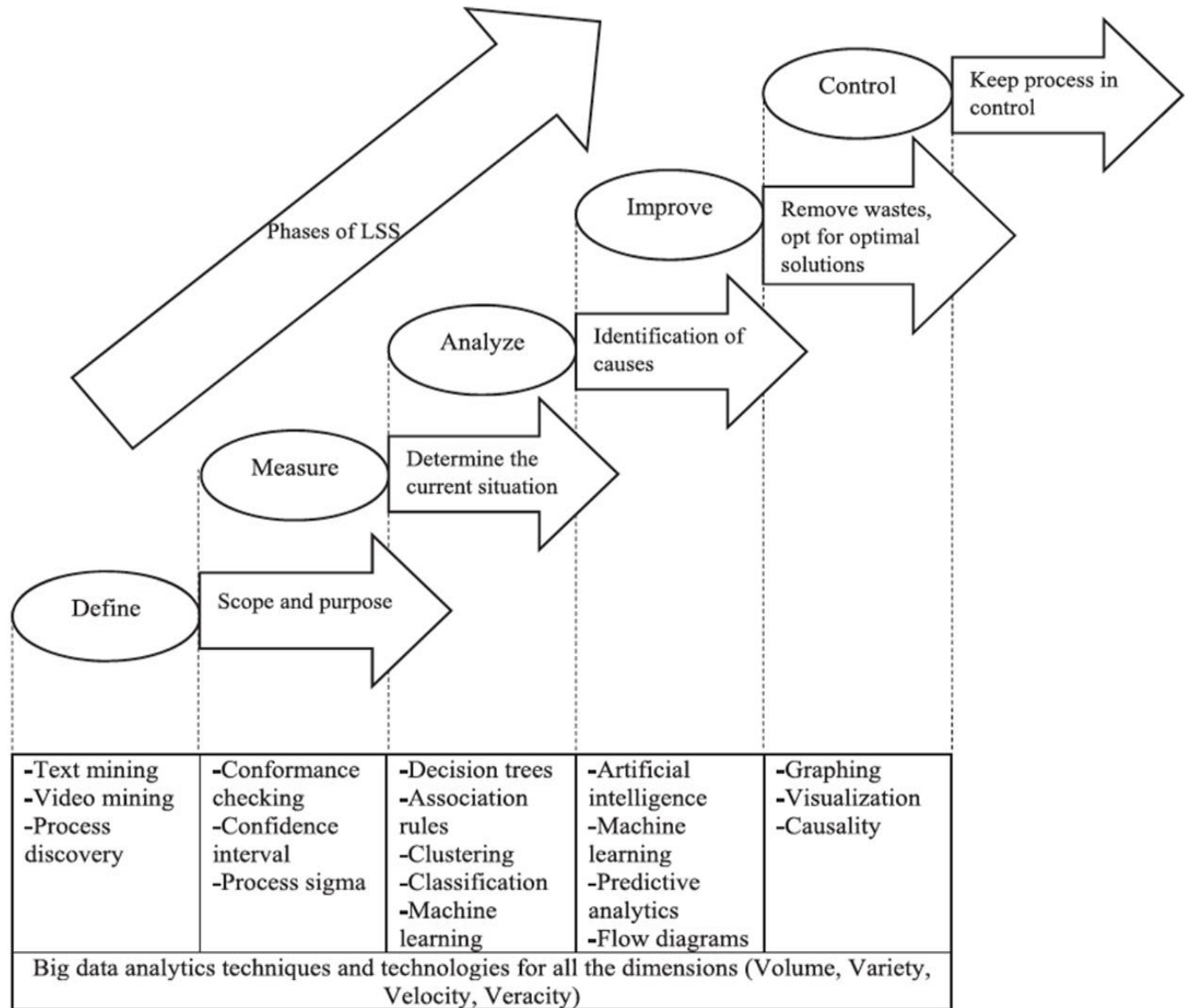
# Data Mining Techniques



- ✓ **Association Analysis**
- ✓ **Clustering**
- ✓ **Classification**
- ✓ **Prediction**
- ✓ *Machine learning*
- ✓ *Text mining*
- ✓ *Video mining*
- ✓ **Process Mining**



# The use of BD in six sigma





## What is Wrench Time?



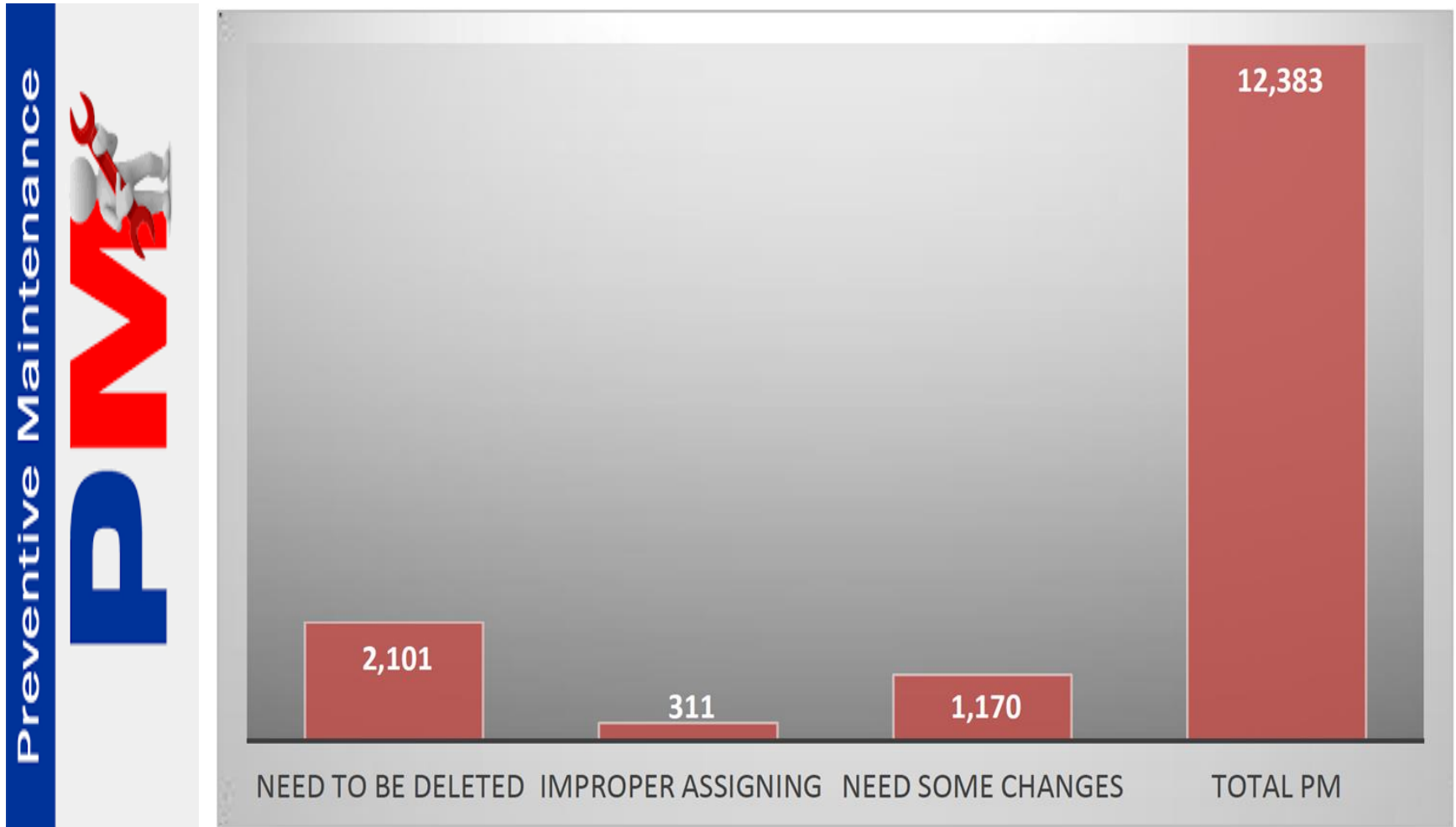
- “Wrench time” or “execution is the percentage of total time worked that a maintenance technician has tools-in- hand and directly applying maintenance to equipment.
- On the other hand, doing an optimization to the PM by having the right time (wrench time), need first to remove unnecessary PMs
- for this reason selecting lean six sigma approach is the appropriate method.

## Case Study



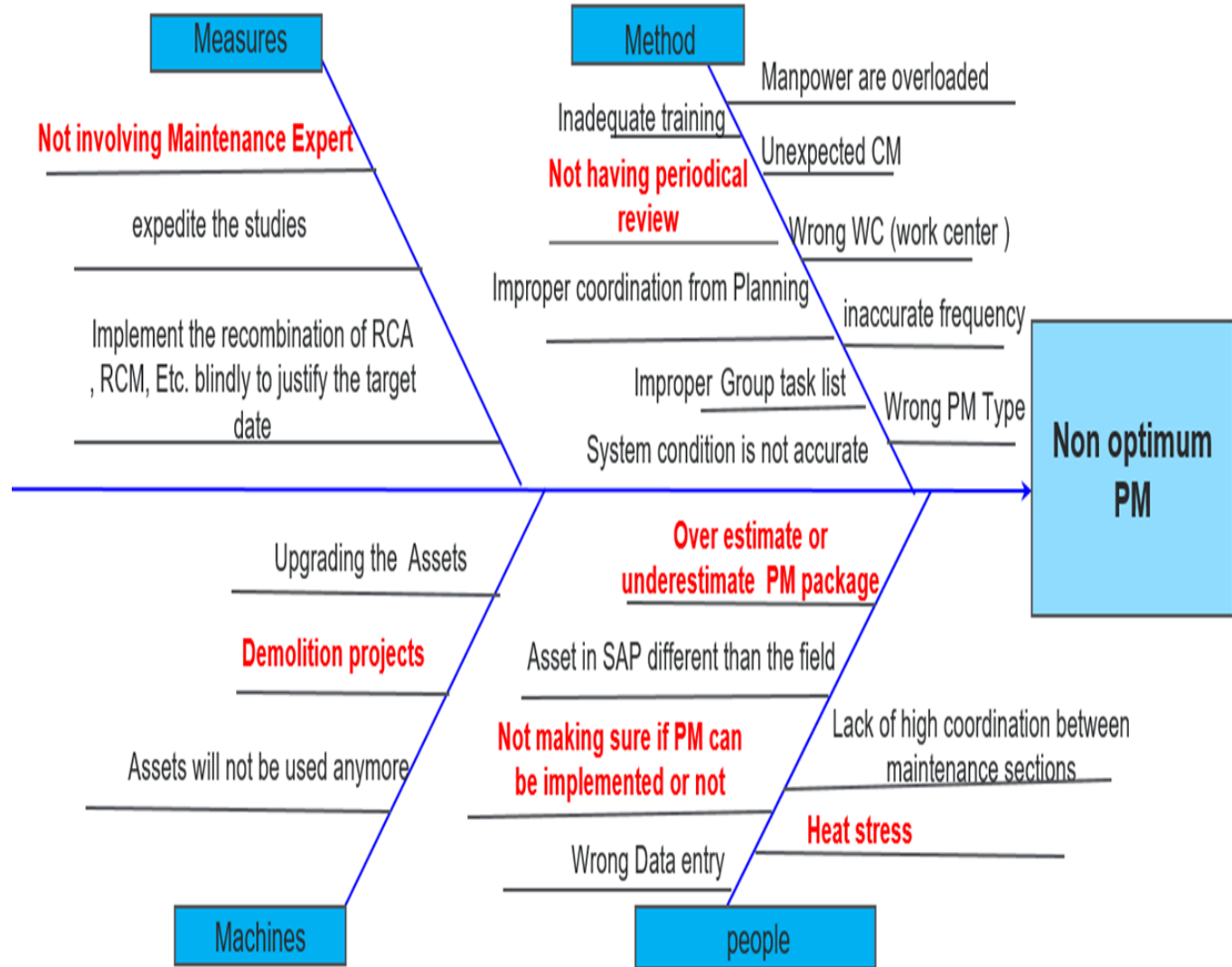
- Preventive maintenance execution duration is not accurate in SAP System (software sending the PM with all related info. such as time, type of PM and frequency).
- 30 % of total PM are non optimal (PM execution duration) which may lead to impact the life cycle of the assets, affecting the reliability of plant

# Total PM with number of defected opportunities PM details



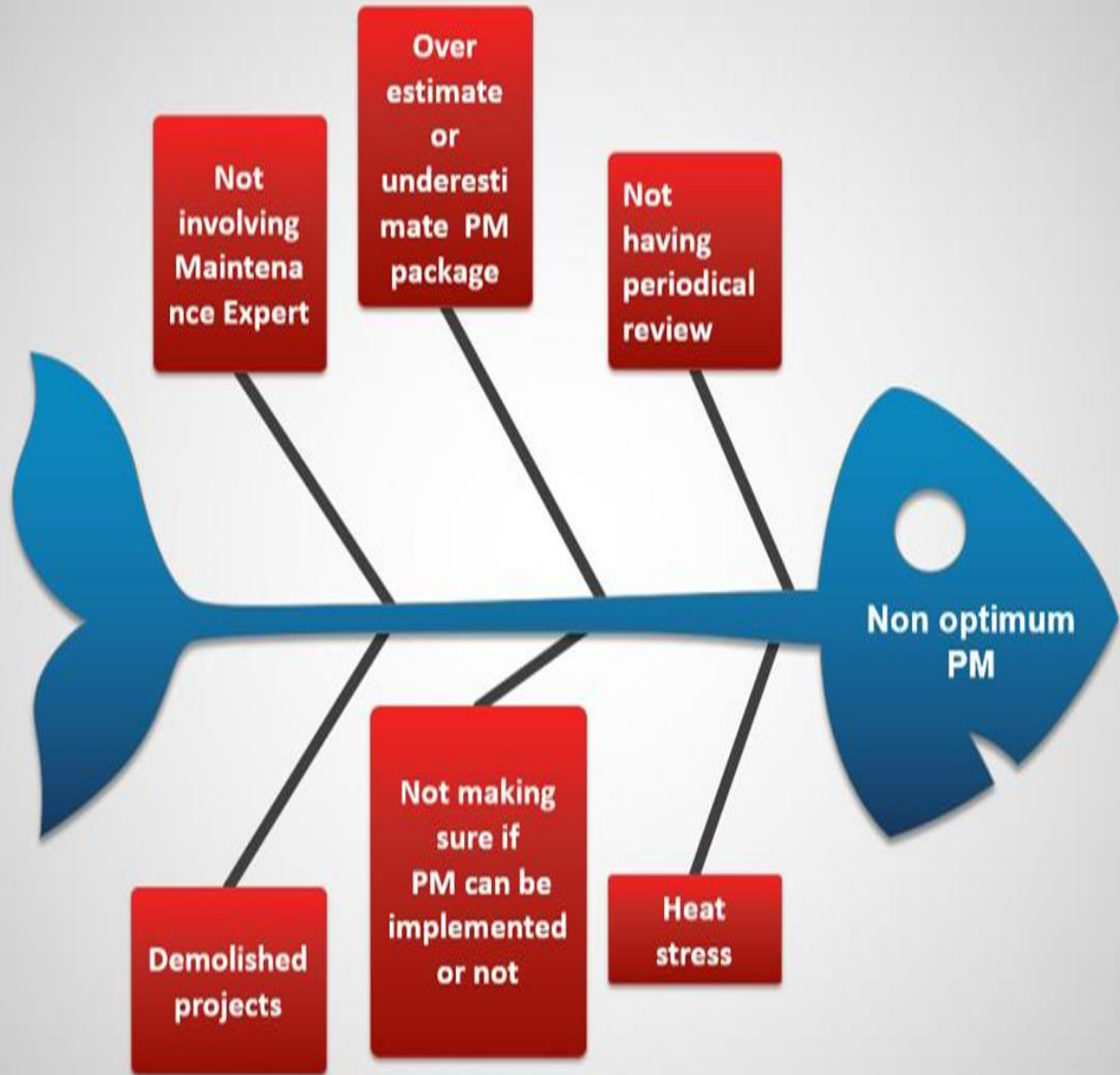


**Major causes of non-optimum preventive Maintenance**





**Fish bond diagram for the voted causes**

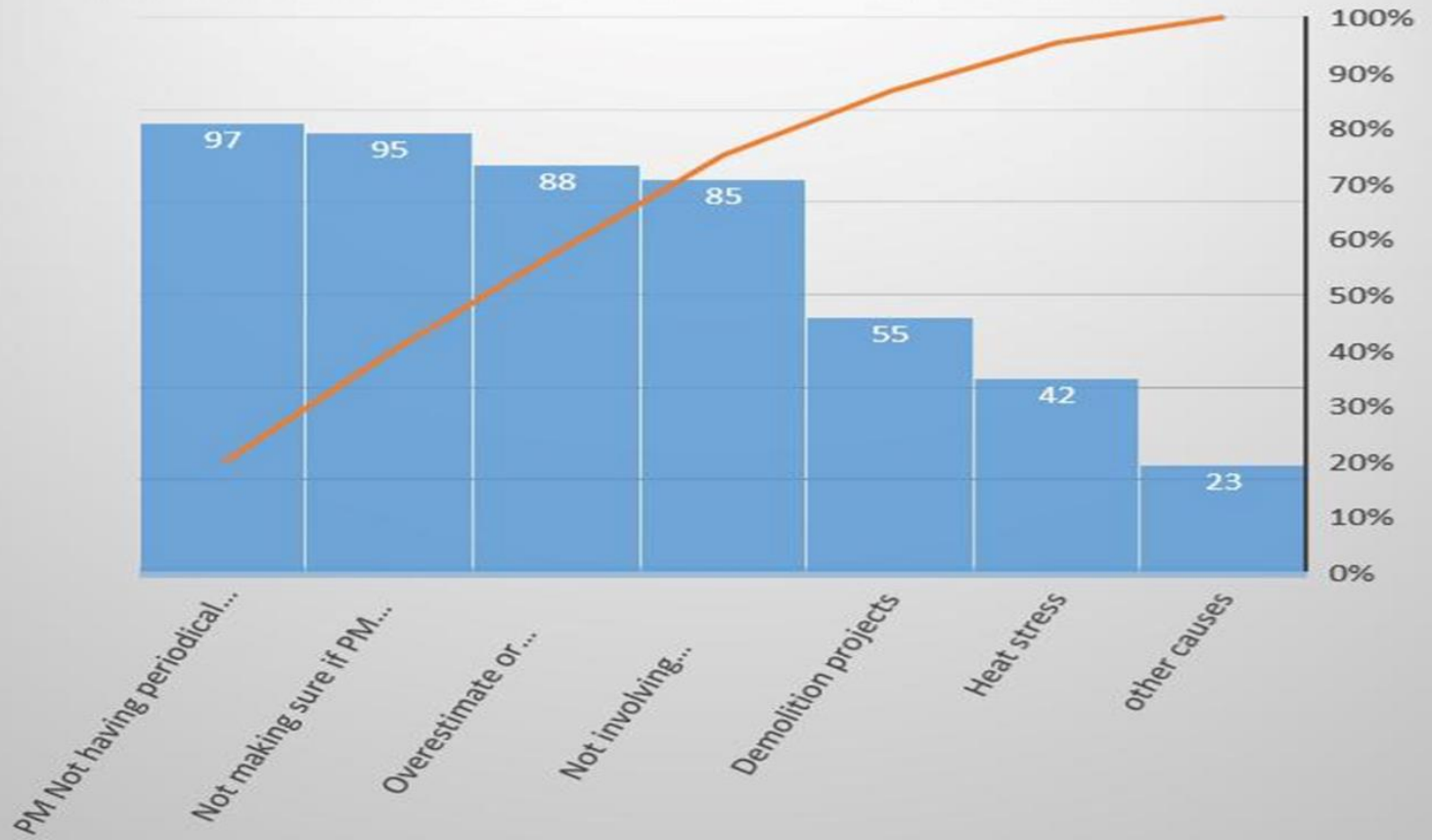


## Summary of PM survey

	Not involving Maintenance Expert	Demolished projects	Overestimate or underestimate PM package (Duration)	Not making sure if PM can be implemented or not	Heat stress	Not having periodical review for the PM	Other causes
Asset Engineering	26	23	31	28	12	34	8
EHSS	3	2	4	2	0	4	1
inspection	17	15	20	22	12	22	5
Maintenance & Routine Planning	26	9	22	28	11	25	6
Turnarounds & Central Maintenance	13	6	11	15	7	12	3
<b>Total</b>	<b>85</b>	<b>55</b>	<b>88</b>	<b>95</b>	<b>42</b>	<b>97</b>	<b>23</b>



## PARETO CHART FOR THE REASONS FOR NOT HAVING PROPER PM EXECUTION TIME





# PM deleted and total annual saving per Year




Reviewing for Deleting	ANAL	MECH	ELEC	INST	IP	AC
	100%	100%	100%	100%	100%	100%
Confirmation by Reliability	100%	100%	100%	100%	100%	100%
Implemented in SAP	100%	100%	100%	100%	100%	100%
PM DELETED	42	30	32	233	35	48
Annual saving (hour) Total 3,329 (HR/Year)	688	180	1203	694	156	408

# The following PM activities were recommended for deleting

- Validate deletion request by reviewing the PM history.
- Delete Obsolete Assets.
- Delete maintenance items.
- Update maintenance plan (Delete or change).
- Delete WO that already available (created and released).
- Adding the history information to each Work Order that is deleted.
- Calculate the saving hours annually (section wise)



# PM changes and total annual saving per Year

		ANAL	MECH	ELEC	INST	IP
 <p><b>PREVENTIVE MAINTENANCE</b></p>	Reviewing for changing	100%	100%	100%	100%	100%
	Confirmation by Reliability	100%	100%	100%	100%	100%
	Impalement in SAP	100%	100%	100%	100%	100%
	PM changed	203	213	225	20	1537
	Annual saving (hour) Total 4,045 (HR/Year)	652	303	1820	8	1262

**The following PM activities need some changes:**



- Task list Update that include work instruction
- Linking and delinking the assets to the right groups
- Maintenance execution duration correction
- Created work order adjustment
- Create missing Task list
- Upgrading the Assets

## Causes recommendation and the Target Date

#	Causes	Recommended	BY (Department )	Target
1	<b>Not involving Maintenance Expert</b>	<ul style="list-style-type: none"> <li>➤ Involve maintenance expert from each section with backup as focal point.</li> <li>➤ Add a filed to the PM form to maintenance expert to confirm the duration of PM execution.</li> </ul>	T/A&MS AED	1Q 2018
2	<b>Demolition projects</b>	<ul style="list-style-type: none"> <li>➤ Material and SAP master engineer should be part of any MOC to make sure PM and Assets is updated in SAP.</li> </ul>	TS	1Q 2018
3	<b>Overestimate or underestimate PM package</b>	<ul style="list-style-type: none"> <li>➤ Involve maintenance expert from each section with backup as focal point.</li> <li>➤ Add a filed to the PM form for maintenance expert to confirm the duration of PM execution.</li> </ul>	T/A&MS AED	1Q 2018
4	<b>Not making sure if PM can be implemented or not</b>	<ul style="list-style-type: none"> <li>➤ One month ahead schedule should be shared with operation to confirm the availability of the Assets</li> </ul>	Routine section	1Q 2018
5	<b>Heat stress</b>	<ul style="list-style-type: none"> <li>➤ Convert most of the PM to be conducted in the Night shift during heat stress</li> </ul>	Routine section	1Q 2018
6	<b>Not having periodical review</b>	<ul style="list-style-type: none"> <li>➤ Quarterly review for the next PM in the upcoming quarter.</li> </ul>	AED	1Q 2018

# Conclusion: Expected results after complete implementation are

- improve safety system availability,
- insure energy system healthiness by reducing required repair time and stopping technicians from going to the areas that assets already demolished;
- increase production volume, quality, and yield by improving system uptime;
- improve plant reliability by timely and quality execution of PM activities and, increase employees productivity and; maximize resources utilization