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Understanding Lean Awareness Gaps between Management and Operations in an Aerospace Manufacturing Company in Malaysia

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Abstract: Lean planning is usually performed by the management team, while lean implementation by the operations team. Lean implementation can be more successful if the gap in lean between the management and operations teams are understood. By knowing the gaps, the right resources can be allocated to the right people doing the right things. This study aims to investigate the gap in lean awareness between both teams. The survey, via Google Form, took place in an aerospace manufacturing company in Malaysia. 360 valid responses received and analyzed with SPSS. Based on the findings, the management team was found to have more working experiences with higher qualifications compared to the operations team. Consistently, the findings have also found the management team has better awareness on lean terminologies, types of waste, and benefits of lean, followed by the technicians and operators, respectively. As a result, there was a clear gap in lean awareness between the management and operations teams. This gap might possibly be influenced by the level of qualifications, and number of experiences. Meanwhile, the findings within the operations team have shown the technicians' awareness on lean is better than the operators. This study implicates that a specific lean awareness program should be designed to suit different level of understanding on lean, for the right people with the right resources. With effective lean program, the implementation will be more successful, and firms can achieve better efficiency and waste reduction.

Keywords: *Benefits of lean, Lean awareness, Lean terminologies, Types of waste in lean*

1. Introduction

Measuring lean awareness is an important step in planning for the lean implementation [1]. Since the level of lean awareness is different between people, identifying the gap in lean awareness between the management and operations groups is critical to create effective lean awareness programs. This means, lean awareness programs can be more successful if the limited time, efforts, and resources can be allocated to the right people and for the right things. In addition, lean awareness is important to the management group as they are responsible for the lean planning. Similarly, lean awareness is important to the operations group as they are involved in the lean implementation. This is crucial because a recent study in Malaysia has found lean management, e.g., on adoption, and integration with supply chain is lacking attention as compared to the international trend [2]. Moreover, the concept of lean management is still not holistically adopted by firms in Malaysia [3]. Because

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lean knowledge significantly affects lean implementation [4], this study aims to understand the gaps in lean awareness between the management and operations groups. The study took place in an aerospace-related company in Malaysia. It has years of experiences in the business and supplies composite products and subassemblies to the global aerospace industry. It has produced many development and sustainability programs. However, this company concerned about effective lean implementation among the employees. They planned to bring in the lean culture, but prior to that, need to understand the employees' awareness on lean. The implementation of lean will be significant to the company to achieve efficiency and better meet the need of the customers.

2. Lean Awareness

The issue of lean awareness is important as shown by a previous study where employee attitude is the common challenge to implementing lean in the aerospace manufacturing companies in Malaysia. One of the reasons is due to the lack of understanding of lean, where the level of lean awareness is still at the surface. It was also found that the employees were skeptical about the benefits of lean [5]. In general, "lean awareness is measured with the extent of knowledge that respondents have about lean terminologies and principles" [6]. Besides that, the principle of waste elimination is also used to measure lean awareness. For instance, lean tools and techniques, wastes, and benefits of lean have been used in the previous study of lean awareness in India [7]. Therefore, this study adopts lean terminologies (tools and techniques), types of waste, and benefits of lean as the three measurements for lean awareness.

2.1. Lean Terminologies

Lean terminologies are important to understand lean awareness among employees. Lean terminologies relate directly to lean tools and techniques. Employees' understanding of lean terminologies suggested that they know the tools and techniques. There are many lean tools and techniques that share a similar objective to eliminate waste, such as scheduling, Value Stream Mapping (VSM), takt time, bottleneck process, group technology, cellular manufacturing, line balancing, flow manufacturing, single minute exchange of die, small lot size, kanban, etc. [6]. A recent study in Malaysia has used 10 lean tools and techniques to study lean awareness comprising 5S, standardized work, kaizen, Plan-Do-Check-Action (PDCA), Total Preventive Maintenance (TPM), poke yoke, kanban, cellular manufacturing, VSM, and jidoka [8]. In addition, a study in India has identified 19 lean tools and techniques, which are no different from the previous studies, such as VSM, takt time, PDCA, Just-in-time (JIT), 5S, and jidoka [7]. Meanwhile, [9] have identified 58 tools and techniques for lean. Since there are many possible lean tools and techniques in literature, this study has shortlisted 26 terminologies (as shown in the findings section) to measure lean awareness in an aerospace manufacturing company.

2.2. Types of Waste in Lean

Waste elimination is one of the principles of lean. Waste in lean can refer to "any activity in a process which does not add value to the customer". To eliminate waste, employees need to understand the types of waste in lean, which include defects, overproduction, waiting, transport, inventory, motion, and overprocessing [10]. According to [11], there are eight types of waste associated with lean, namely defects, overproduction, waiting, transportation, inventory, motion, extra-processing (or overprocessing), and non-utilized talent (or skill). These types of waste were consistently used in previous studies, such as in India [7]. This implies that the mainstream literatures are consensus with the eight types of waste with acronym DOWNTIME or TIMWOODS for remembering purpose. Therefore, all the eight types of waste in lean were selected to measure lean awareness in this study.

2.3. Benefits of Lean

There is no point in implementing lean if the benefits are unclear. This means lean awareness exists if the employees recognize the benefits. A study has identified six typical benefits of lean for non-process industries, namely less process waste, reduced inventory, increased process understanding, financial savings, less rework, and reduced lead-time [10]. Meanwhile, [7] have listed the benefits of lean comprising floor space utilization, quality improvement, cost minimization, better supply chain management, employee motivation, market and financial performance, leadership, and productivity, communication, health, and safety. Another study has listed 14 benefits of lean including reduced waste, improved product development, improved profitability, increased customer satisfaction, increased productivity and efficiency, improved product/service quality, etc. [12]. Since numerous benefits of lean have been publicized in literature for more than three decades [13], this study has shortlisted 18 benefits (as shown in the findings section) for measuring lean awareness in the aerospace manufacturing company in Malaysia.

3. Study Methodology

To identify the gaps in lean awareness, this survey has targeted employees from both managerial and operational levels of an aerospace manufacturing company in Malaysia. The questionnaire was finalized according to the literature in Section 2, comprising the respondents' background (three items), lean terminologies (Section 2.1), types of waste (Section 2.2), and benefits of lean (Section 2.3). The first two sections were measured with a nominal scale, while the latter two with a 5-point Likert scale. All items in the questionnaire were face- and content-validated by the management team prior to its dissemination in the first half of 2019 via Google Forms. The data were quantitatively analyzed with SPSS for

descriptive analysis and comparing the groups. The findings are summarized and descriptively reported as follows:

3.1. Respondent Position

The survey was responded to by 365 employees of the aerospace manufacturing company in Malaysia. The responses consist of eight managers (2.2%), 10 engineers (2.7%), and 21 executives (5.8%) from the management group, while 131 technicians (35.9%), and 190 operators (52.1%) from the operations group. Besides that, five respondents (1.4%) cannot be classified into any group. Since this study is focusing on the gap in lean awareness between the management and operations groups, these unclassified responses were excluded for analysis. As a result, 360 (98.6%) responses are valid for analysis. It was also found that the respondents' compositions are well representing the overall job compositions in the company. Because 88.0% of total responses come from the operations group, this study has separated this group further into the technicians and operators. Thus, this study is analyzing the gaps in lean awareness between three groups, namely the management group, and the operator and technician groups from the operational level. See Table 1 for the details.

Table 1. Respondent Position

Group	Statistics
Management:	39 (10.7)
Manager	*8 (2.2)*
Engineer	*10 (2.7)*
Executive	*21 (5.8)*
Operations:	321 (88.0)
Technician	*131 (35.9)*
Operator	*190 (52.1)*
Other	5 (1.4)
Total	**365 (100.0)**

3.2. Respondent Experience

Table 2. Respondent Experience

Working experience	Overall score	Managemen t group	Operations group	
			Technician	Operator
1-5 years	156 (43.3)	11 (28.2)	55 (42.0)	**90 (47.4)**
6-10 years	137 (38.1)	9 (23.1)	44 (33.6)	**84 (44.2)**
11-15 years	40 (11.1)	**7 (17.9)**	20 (15.3)	13(6.8)
16-20 years	22 (6.1)	**11 (28.2)**	8 (6.1)	3 (6.8)
21 and above	5 (1.4)	1 (2.6)	**4 (3.1)**	0 (0.0)
Total	**360 (100.0)**	**39 (100.0)**	**131 (100.0)**	**190 (100.0)**

In term of working experiences, the survey was responded by 156 (43.3%) respondents with no more than five years of experiences, 137 (38.1%) respondents with between 6-10 years of experiences, 40 (11.1%) respondents with between 11-15 years of experiences, 22 (6.1%) respondents with between 16-20 years of experiences, while only five respondents (1.4%) with more than 20 years of working experiences. When compared between groups, it appears that the group of operators has 91.6% respondents with working experiences of between 1 to 10 years. The management group has 46.1% respondents with working experiences of between 11 to 20 years, while the technician group has 3.1% respondents with working experiences of more than 20 years. All the above percentages are exceeding their respective overall percentages. This implies that while the operations group is dominated by the employees with experiences of no more than 10 years, the management group is dominated by the employees with experiences of more than 10 years. In other words, the employees at the managerial level generally have worked for the company longer than the employees at the operational level. Refer to Table 2 for the details.

3.3. Respondent Qualification

As shown in Table 3, based on the percentage, almost two-third (68.1%) of the respondents are qualified with a certificate, 17.8% with a diploma, and 9.7% with a bachelor's degree. When comparing between groups, it was found that the bachelor's degree (64.1%), master (5.1%), and PhD (2.6%) are dominated by the respondents from the management group, diploma (29.8%) is dominated by the technician group, and certificate (85.8%) is dominated by the operator group. In other words, two-third (71.8%) of the management group hold at least a bachelor's degree, 89.3% technicians hold certificates and diplomas, while many of the operators hold certificates (85.8%). Meanwhile, five respondents did not specify their qualifications. Although some respondents from the management group have lower qualifications, the findings are generally confirming that the management group has the highest qualifications, followed by the groups of technicians and operators, respectively.

Table 3. Respondent Qualification

Qualification	Overall score	Managemen t group	Operations group	
			Technician	Operator
Certificate	245 (68.1)	4 (10.3)	78 (59.5)	**163 (85.8)**
Diploma	64 (17.8)	7 (17.9)	**39 (29.8)**	18 (9.5)
Degree	35 (9.7)	**25 (64.1)**	8 (6.1)	2 (1.1)
Master	2 (0.6)	**2 (5.1)**	0 (0.0)	0 (0.0)
PhD	2 (0.6)	**1 (2.6)**	1 (0.8)	0 (0.0)
Not specified	5 (1.4)	0 (0.0)	5 (3.8)	7 (3.7)
Total	**360 (100.0)**	**39 (100.0)**	**131 (100.0)**	**190 (100.0)**

4. Findings

4.1. Lean Terminologies

In general, all respondents have various familiarity on lean terminologies from as familiar as the 5S (89.7%) to as unfamiliar as the quick changeover (30.8%). As shown in Table 4 (sorted by the overall score in familiarity), it was found that the management group has the highest familiarity on all 26 lean terminologies compared to the operations group (technicians and operators). The management's familiarity with all terminologies is also higher than the overall score. In fact, 5S and kaizen were rated 100% by the management. Meanwhile, the technicians have higher familiarity than the operators on 21 of 26 lean terminologies, with 16 of the terminologies rated above the overall score. In contrast, the operators are only familiar with one terminology rated above the overall score, which is for the quick changeover (31.6%). The operator's familiarity on the rest of terminologies is less than the overall score. It can be concluded that the management group has the most familiarity with the lean terminologies, followed by the groups of technicians and operators, respectively.

Table 4. Lean Terminology

Lean terminology	Overall score	Management score	Operations score	
			Technician	Operator
5S	323 (89.7)	**39 (100.0)**	122 (93.1)	162 (85.3)
Continuous improvement (Kaizen)	226 (62.8)	**39 (100.0)**	82 (62.6)	105 (55.3)
Flow manufacturing	222 (61.7)	**34 (87.2)**	86 (65.6)	102 (53.7)
Inventory	200 (55.6)	**37 (94.9)**	74 (56.5)	89 (46.8)
Standardized work	197 (54.7)	**37 (94.9)**	78 (59.5)	82 (43.2)
Scheduling	194 (53.9)	**36 (92.3)**	79 (60.3)	79 (41.6)
Visual controls	191 (53.1)	**34 (87.2)**	81 (61.8)	76 (40.0)
Just-in-time (JIT)	175 (48.6)	**35 (89.7)**	62 (47.3)	78 (41.1)
Takt time	174 (48.3)	**32 (82.1)**	71 (54.2)	71 (37.4)
Setup time reduction	170 (47.2)	**27 (69.2)**	62 (47.3)	81 (42.6)
Kanban	163 (45.3)	**34 (87.2)**	61 (46.6)	68 (35.8)
Cellular layout	161 (44.7)	**22 (56.4)**	60 (45.8)	79 (41.6)
Group technology	159 (44.2)	**30 (76.9)**	58 (44.3)	71 (37.4)
Total productive maintenance (TPM)	156 (43.3)	**29 (74.4)**	59 (45.0)	68 (35.8)
Small lot size	153 (42.5)	**23 (59.0)**	59 (45.0)	71 (37.4)
Line balancing	152 (42.2)	**29 (74.4)**	57 (43.5)	66 (34.7)
Quality at source	149 (41.4)	**23 (59.0)**	57 (43.5)	69 (36.3)
Pull system	127 (35.3)	**25 (64.1)**	46 (35.1)	56 (29.5)
Bottleneck process	125 (34.7)	**26 (66.7)**	39 (29.8)	60 (31.6)
Poke yoke	124 (34.4)	**32 (82.1)**	40 (30.5)	52 (27.4)
U-line manufacturing system	124 (34.4)	**20 (51.3)**	40 (30.5)	64 (33.7)
QC circle	121 (33.7)	**17 (44.7)**	43 (32.8)	61 (32.1)
Autonomation (Jidoka)	120 (33.3)	**25 (64.1)**	41 (31.3)	54 (28.4)
Value stream mapping (VSM)	120 (33.3)	**27 (69.2)**	36 (27.5)	57 (30.0)
Production grouping (Heijunka)	112 (31.1)	**15 (38.5)**	38 (29.0)	59 (31.1)
Quick changeover	111 (30.8)	**15 (38.5)**	36 (27.5)	60 (31.6)
Familiarity average	163.5 (45.4)	**28.5 (73.2)**	60.3 (46.0)	74.6 (39.3)

4.2. Types of Waste in Lean

Table 5 (sorted by the overall mean score) shows the respondents' agreement on eight types of waste in lean. In general, the most important type of waste rated by the respondents is defects with the overall score of 3.56, while the less important wastes are overprocessing and transport, both with the overall score of 3.44. Accordingly, the management group of respondents have the highest mean score on defects (3.97) compared to the groups of technicians (3.50) and operators (3.52). Despite that, the management

group rated waiting (4.03) as the most important waste of lean, which is also the highest mean score reported for wastes. Based on the findings, without any doubt the management group has the highest mean scores for all types of waste compared to the operations group. The mean scores are also higher than the overall scores for all types of waste. This means the management group has above average awareness on all types of waste in lean. Surprisingly, the group of operators has the mean scores higher than the group of technicians on six of eight types of waste except for overproduction and skills. Despite that, the differences between them are not obvious. For example, the mean score for waiting is 3.46 for technicians and 3.47 for operators. These scores are also below the overall mean score of 3.52 for waiting. It can be concluded that the awareness level on all types of waste is found to be led by the management group, followed by the operators, and technicians.

Table 5. Types of Waste in Lean

Types of waste	Overall score	Management score	Operations score	
			Technician	Operator
Defects	3.56	**3.97**	3.50	3.52
Waiting	3.52	**4.03**	3.46	3.47
Motion	3.48	**3.95**	3.40	3.43
Inventory	3.47	**3.90**	3.39	3.44
Overproduction	3.47	**3.92**	3.44	3.39
Skills	3.45	**3.82**	3.43	3.39
Overprocessing	3.44	**3.79**	3.33	3.45
Transport	3.44	**3.92**	3.23	3.48
Mean average	3.48	**3.91**	3.40	3.45

4.3. Benefits of Lean

Table 6. Benefits of Lean

Benefits of lean	Overall score	Management score	Operations score	
			Technician	Operator
Work environment improvement	3.64	**4.23**	3.66	3.49
Waste reduction	3.63	**4.23**	3.63	3.51
Customer satisfaction improvement	3.61	**4.21**	3.52	3.55
Delivery lead time improvement	3.60	**4.18**	3.51	3.54
Productivity improvement	3.59	**4.18**	3.60	3.47
Employee morale improvement	3.58	**4.18**	3.58	3.46
Quality improvement	3.58	**4.05**	3.63	3.45
Product cost reduction	3.56	**4.15**	3.52	3.47
Product cycle time reduction	3.54	**4.00**	3.55	3.44
Reduction in inventory group	3.53	**4.05**	3.53	3.43
Rejection rate reduction	3.52	**3.95**	3.54	3.42
Communication flow improvement	3.51	**4.21**	3.43	3.43
Process flexibility improvement	3.50	**4.10**	3.49	3.38
Setup time reduction	3.50	**3.90**	3.52	3.41
Machine downtime reduction	3.49	**3.97**	3.54	3.36
Meeting customer demand	3.47	**4.21**	3.53	3.28
Supplier lead time reduction	3.44	**3.79**	3.40	3.39
Lot size reduction	3.38	**3.69**	3.31	3.37
Mean average	3.54	**4.07**	3.53	3.44

According to the overall score in Table 6, the highest benefit of lean rated by the respondents is work environment improvement (3.64), while the less important benefit is lot size reduction (3.38). Just like the findings on lean terminologies and types of waste, the management's mean scores on all benefits of lean are higher than the technician and operator groups, which is also above the overall scores. In fact, 13 of the terminologies have the mean scores of 4.00 and above. Meanwhile, the technicians have more awareness than the operators on 14 of 18 benefits of lean. However, only eight benefits of lean have achieved a mean score above the overall score. In summary, the management group leads the awareness on the benefits of lean, followed by the technicians and operators, respectively.

5. Discussion

Previous study has found top management and employee competency were among the challenges for the success of lean implementation [5]. As such, lean implementation needs commitment from both managerial and operational levels. Hence, any existing gap in lean awareness should be identified and narrowed between them. Based on the findings, there is a clean gap in lean awareness between the management and operations groups on lean terminologies, types of waste, and benefits of lean. This is evidenced by the management scores that are all above the overall score and exceeding all scores of the operations group. Meanwhile, the gap in lean awareness within the operations group is not always clear between the technicians and operators. The gap between management and operations groups could exist due to the differences in experiences and knowledge.

5.1. Management Group

The management group was represented by the managers, engineers, and executives. This group contributed 10.7% of all responses. It has the highest percentage of respondents with the working experiences of between 11 to 20 years. It also has the highest percentage of respondents with the bachelor's degree, master, and PhD. The findings show the management group has the highest awareness level on lean terminologies (familiarity average of 73.2%), types of waste (mean average of 3.91), and benefits of lean (mean average of 4.07) compared to the operations group. This implies that the management group is ready and committed to implement lean manufacturing. However, due to the gap in lean awareness, they need to communicate lean in a way that is easy but effective to the operations group. This is important because the operations group may have different understanding and ways of thinking about lean.

5.2. Technician Group

The technician group represents about one-third or 35.9%

of all responses. Even though this group has the highest percentage of diploma holders compared to the other groups, almost 60% of the respondents hold certificates as the highest qualification. This group also has the highest number of respondents with more than 20 years of working experience, although with just four people (or 3.1%). This means there are very few people with above 20 years of experience currently working with the company regardless of the groups. Despite that, the technician group is not dominating any other categories of working experiences (in percentage). Based on the findings, this group has achieved the second highest level of lean awareness after the management group on lean terminologies (familiarity average of 46%) and benefits of lean (mean average of 3.53). On the other hand, this group also has the lowest awareness on the types of waste in lean (mean average of 3.40) compared to the group of operators (mean average of 3.45). The reasons why they have the lowest awareness on the types of waste should be investigated further. In addition, the technicians' mean average for the types of waste and benefits of lean is lower than the overall average, which is a similar case with the operators. Therefore, the gap in lean awareness does exist between technicians and operators but minimal.

5.3. Operator Group

The operators represent 52.1% of total responses, which makes them as the biggest group of respondents in this study. This group has the highest percentage of respondents with the working experiences of less than 10 years. In addition, more than 80% of the respondents possess a certificate as the highest qualification. When compared to the group of technicians, the operators have the lowest level of lean awareness on lean terminologies (familiarity average of 39.3%), and benefits of lean (mean average of 3.44) but scores higher than the technicians on the types of waste in lean. However, none of the operators' mean averages exceed the overall average. Although the operators generally have the lowest level of awareness on lean, the gap with the technicians is not large. This is not surprising since both operators and technicians shared many similarities e.g., background, and both are also within the operations group.

6. Conclusion

For lean implementation to be successful, people commitment from both managerial and operational levels is required. Knowing the level of lean awareness within an organizational hierarchy is crucially important because the management group is usually involved with the lean planning, while the operations group with the lean implementation. Any gap in lean awareness between them will impose challenges to embrace lean manufacturing. As such, understanding the gap will enable the company to allocate limited time, efforts, and resources to the right people with the right things. This study has found a clear gap in lean awareness between the management and operations groups, where the management group has all above the overall scores for lean terminologies, types of waste, and benefits of lean. One of the possible reasons for the gap may be due to the differences in the background, e.g., levels of education and working experiences. The gap may as well affect lean communication between the groups. Miscommunication can be the biggest barrier to communicate lean effectiveness. As such, it is important for the company to identify the best way to communicate lean between different groups in a manner that is easy but effective. Because transferring lean knowledge is very crucial especially for multinational firms [14], it is suggested for better knowledge transfer, suitable lean programs should be designed for different people in accordance with their understanding on lean concept. With limited resources on hand, the company should prioritize the programs to increase effective communication between groups and to enhance lean awareness within the operations group. This study implies the level of understanding on lean are dissimilar between people and may exist regardless of firms. By identifying the differences should help any firms to design the right program for the right people with the right budgets and resources. With effective lean program, lean can be implemented in firms that will result in significant waste reduction, higher efficiency, employees' engagement, and customer satisfaction.

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