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## Laboratory Quality Management Requirements of Engineering at the Polytechnics Ministry of Higher Education Malaysia

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### Abstrak

Laboratorium teknik merupakan instrumen teknikal dari pengajaran. Kontinuitas teori pembelajaran di kelas akan diterapkan di laboratorium untuk pemahaman dan paparan keterampilan teknik. Makalah ini merupakan studi yang menjelaskan aspek utama manajemen mutu di laboratorium teknik (laboratorium) untuk menyediakan fasilitas belajar dan mengajar di laboratorium. Peran dan akuntabilitas pengelolaan laboratorium memastikan proses manajemen yang tepat, persiapan dan pelaksanaan pekerjaan laboratorium teknik bagi mahasiswa. Temuan dari studi literatur menimbulkan isu-isu penting yang berkaitan dengan manajemen mutu laboratorium dan harus ditangani oleh personil manajemen laboratorium. Kekuatan pengelolaan sebuah laboratorium teknik, tergantung pada hubungan antara manajemen dan jaringan departemen, manajemen laboratorium, staf pengajar dan mahasiswa. Elemen kunci dari manajemen mutu adalah manajemen dokumentasi laboratorium teknik, keselamatan, lingkungan dan perangkat manajemen.

Kata kunci: *dokumentasi, kerja lab, lab keteknikan, manajemen kualitas laboratorium, perangkat manajemen*

### Abstract

Engineering lab is instrumental in the technical fields of study. Continuity of learning theories in the classroom will be applied in the laboratory for understanding and exposure to engineering skills. This paper is a study that outlines the main aspects of quality management in the engineering laboratory (lab) to provide learning and teaching facilities in the labs. The roles and accountability of the lab management ensure appropriate management processes, preparation and execution of engineering laboratory work for students. A finding from the literature study raises important issues relating to laboratory quality management and should be addressed by the laboratory management personnel. Soundness of management of an engineering lab, depends on the relationship between management and department network, laboratory management, teaching staff and students. The key element of quality management is the management of engineering laboratory documentation, safety, environment and management tools.

**Keywords:** *documentation, engineering lab, lab work, laboratory quality management, management tools*

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## **Introduction**

Education in engineering is one branch of studies that is important and of high priority in the education sector in the country. The mission and vision are to produce students who are semi-skilled workers for the needs of industries in this country. Job-oriented education system can be seen if we examine the structure of the curriculum and learning, particularly at the secondary level. The flow of academic and technical vocational education also includes work for semi-skilled jobs created to provide a basic foundation for youths. Education at colleges and universities is more specialized and range from qualified youths to professional members in particular.

Technical fields are offered at the polytechnics however lecturers are in dire need of competence in certain areas. This is crucial in the teaching and learning activities in engineering. Technical fields of study emphasize the practical skills in the laboratory as part of their ongoing course evaluation. The courses aim to provide understanding of the theories that have been studied in engineering and science and to merge their relationship of theory in practical classes. In this regard, some important aspects needs to be addressed by senior management and laboratory management in providing quality laboratory facilities at all levels according to the needs of teaching and learning process. Aspects of concern are the aspects of documentation management, safety, environment and management tools.

## **Engineering Lab**

Management Engineering Laboratory has evaluated the effectiveness of management which includes documentation of labs, lab environment, safety and equipment. Ahmad Fauzi's study (2005), suggests Ministry of Higher Education should streamline management of physical resources to avoid wastage and to formulate strategies to help guide the institution to achieve their visions and goals. According to Fauzi, they have a user property and objects (physical resources) are great. The size of this resource inventory is to provide the cost, maintenance and operations and technical complexities which are developing rapidly. Elements of quality management are to ensure that key aspects can be implemented efficiently. Accountability and skills possessed by the laboratory management are very helpful in shaping the quality of engineering labs. Khairani Mohamad's study (2007) found that the technicians played an important role in engineering management at the Faculty of Engineering UTHM. The technicians carry out their duties as laid down in clause 5.5 of ISO 9001:2000 (responsibility, authority and communication). Md. Nazri's findings (2004) was on the implementation of the regular teaching and learning activities in the lab, the quality of lectures and type of practical work that followed after a clear explanation of tasks were carried out. These were the contributing aspects of improving laboratory management system. However, other aspects need to be addressed, such as inadequate equipment, limited space, not comfortable to travel, equipment failure thus making the work of other lecturers result in unsatisfactory practical laboratory management. This should be monitored systematically by management to ensure that laboratory services consistently meet the needs of teaching and learning situations at all times.

Laboratory management is a very important element during the teaching and learning process especially when it involves practical work for engineering students. Rynja's findings (2006) on performance evaluation of labs were based on factors that correlate with economy such as price, quality and delivery time. According to Malhan (2001), there is also the financial situation affecting the quality of the laboratory in the management of all materials and service requirements, hence workers and their performances are key to organizational effectiveness.

In order to ensure the organization's .....the management should examine several aspects of the context (the organizational culture and relationships between groups), staff management (teamwork, leadership and support), psychological interests of workers (health and stress, commitment, knowledge, skills and motivation), employee attitudes and organizational performance. Nurzatulshima et al. (2009) found that surveillance and criticisms during laboratory work in progress (when lab assistant monitors students) helped to increase the students' involvement in practical classes. The active involvement of students in teaching and learning process helps in the production of human capital that features aspects of creativity, being critical and innovative.

To ensure laboratory quality management in the technical field, commitment by top management, laboratory management, lecturers, technicians and students should be focused. This helps to provide the needs of the facility for laboratory practical work. Concentration of the nature and scope of work is an effective factor in managing a laboratory. Every employee from top management down to the lower levels need to understand each other's scope of work. According to Goetsch (2000), all the equipment utilised in the teaching and learning process, should be inspected and tested beforehand, in

order to ensure conformity with standards of appropriate use. The emphasis is on inspection of equipment to ensure it functions. Good supervisors will also conduct further tests on the equipment to ensure they are set according to the specifications. This organizational culture helps produce increased innovation in the lab. Sources and working environment are also among the factors involved in innovation of learning. To manage the facility, employees must possess three characteristics, namely accountability, teamwork and a sense of pride in work matters.

Mokhtar (2007) gives the view that the effectiveness of engineering laboratories at the polytechnics depend on factors of laboratory management, procurement of equipment and material experiments. The management and administration of laboratories are to determine that the process of testing in labs or workshops can be implemented effectively. Management does not have to overs in the laboratory, but more importantly provides guidance and procedures which can be applied all the time consistently in any laboratory. Management and administration of TVE in educational institutions requires an injection of change. It is not solely based on the pyramid and the top-down policy. The management should continuously monitor and provide the needs of the laboratory as part of the teaching and learning process.

## Methodology

Descriptive research is employed to study the internal customer satisfaction of the laboratory quality management at Polytechnic Sultan Salahuddin Abdul Aziz Shah. The data was collected by distributing questionnaires to all staff involved to review. A Likert scale of 1 to 7 will be used as responses and it will be further categorized into three levels, namely the high (very satisfied), medium (satisfied) and lower (less satisfied). This study uses the census sampling technique. The data will be analyzed using the SPSS software. Each question in the questionnaire will be computed using a mean score. The mean score will be compared with the average mean score of each item examined to determine which aspect has the lowest mean score. If the aspects of the mean score is lower than the average mean, this means that the staff is still not satisfied, making it an indicator to make recommendations for corrections or improvements.

## Findings and Discussion

In the technical field, most of the teaching and learning activities are carried out in the laboratory. Refer to Table 1 below, there are some issues that need to be improved to ensure the smooth management of engineering laboratories and practical work.

Table 1. The study of internal customer satisfaction (staff)

No.	Item	Year		
		2006	2007	2008
1	Sufficient equipment and practical needs	3.2396*	4.4024*	4.1924*
2	Equipment and practical work fully operational	3.2240*	4.3855*	4.1041*
3	Satisfactory laboratory environment	3.5755*	4.6265*	4.4258*
4	Satisfactory environment in workshop	3.5833	4.6981	4.4069*
5	Safety regulations exhibited in laboratory	4.1016	5.1333	5.0694
6	Safety Regulations displayed in workshop	4.0755	5.1432	5.0851
7	Periodic maintenance workshop equipment conducted as scheduled	3.7109	4.7500	4.5930
	Mean score of less than average mean score	3.5813	4.6865	4.5028

The findings of the study was conducted based on staff satisfaction of Polytechnic Sultan Salahuddin Abdul Aziz Shah for three consecutive years. It was found that four key issues needed to be addressed and improvements to be made in laboratory management such as the need of practical work, equipment, environment and maintenance of labs. The Customer Satisfaction Survey showed that the same problems occurred every year. They were management of equipment, environment and safety. No rectifications were done by the management. In this regard if proper planning which involved all parties is done, the matters raised can be resolved.

The supervisor must ensure that laboratory management guidelines are practiced by the laboratory coordinator. This is to ensure that laboratory administrators clearly understand the scope of work to be done. Apart from the lab coordinator, lecturers and students are also responsible for ensuring that it is in good condition. Lecturers need to help the administrators of the laboratory module to ensure practical requirements are in place prior to any practical is implemented. Students need to

assist management in ensuring the smooth flow of laboratory activities such as use of equipment and maintaining a laboratory environment. In order to ensure smooth running of practical work, laboratory management must schedule each year to plan material requirements for testing and obtain them at the beginning of every semester. In this way lecturers can design, plan and determine the needs of the students based on materials provided for teaching.

The existing equipment in the laboratory must also be in proper operation. The result of the study is to see the shortcomings in the management of equipment. Certainly these problems will lead to disruption or delay in students carrying out practical work. Azizi (2008) states that the factor of safety, equipment, environment and management has an effect on the effectiveness of teaching and learning process in the workshop.

Management viewed the latest lab and found that there are still some weaknesses that need to be addressed. Human factors are the main causes of the inefficiency of management (Nazri (2004), Mohamad Khairani (2007)). To increase effectiveness of the management, quality management should evaluate all aspects of laboratory management through assessment. An evaluation mechanism should be established through a number of key criteria in terms of documentation, security, environment and equipment. This assessment should be evaluated by customers who use the laboratory. The evaluation or findings are then reported in terms of percentage of achievement. Through a set of reports by the laboratory management, top management can take immediate action to eradicate the problems.

If this mechanism can be implemented every semester, the problem would be reduced minimally and achieve a level whereby the laboratory quality management system will become stable. Management requires a combination of engineering laboratories of all parties involved. The top management and the supervisor of the laboratory should always communicate the requirements to ensure that they are implemented carefully. Proper planning allows users (lecturers and students) to carry out practical work in accordance with the curriculum. According to Nurzatulshima (2008), management intends to make things work. Many studies conducted in laboratory management; focus on four main aspects, namely laboratory documentation, laboratory safety, environmental laboratories and laboratory equipment. The findings of Dwolatzky et al (1998) view on teaching topics such as power engineering, telecommunications and control network which requires proper laboratory equipment. The laboratory equipment should always be in a state ready for use. Laboratory supervisors, technicians and lecturers should ensure that all equipment modules function properly, the capacity of equipment is sufficient for all students. These requirements must be met before practical work is implemented.

Maslina (2008) highlighted that the laboratory staff, the chief laboratory technician and a lab assistant, depending on the needs of a laboratory and organization. Hence, commitment and continuity should be present in the management of a laboratory evaluation. Mohd Hazwan (2006) considers the documentation can also be a source of reference for the development of future work. Furthermore, it facilitates document updates in accordance with time.

The main equipment in the lab facilities should be sufficient. They should be maintained and fully utilized. Students should be given ample opportunities to use any laboratory equipment that are appropriate to the course. Stephen (1999) found that safety at work / lab is a branch of management and so should be designed to reduce any untoward incidents among staff and students.

According to Elizabeth (1995) service quality begins from the top (management) by their dedication. The Management should also provide ongoing advice and training to clients and staff in conducting customer relations. Training should be implemented at various levels /methods of management training, leadership, teamwork training, personality training. This is useful in linking supervisors, lecturers, lab supervisors, technicians and students together to understand the roles of each other within the organization.

## **Conclusion**

The improvements to be performed by the laboratory management are aimed to ensure all parties directly involved in laboratory activities are satisfied with the quality of management. Increasing the quality of management enables students to apply the theories as planned in the curriculum. Besides that communication between upper management and laboratory management should improve to ensure effectiveness in the management of labs. Hence, management should always strive to adhere to customers' satisfaction by conducting research every year.

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