

ASEAN Industrial Engineering and Work Measurement Practices Phenomenon

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Abstract

Work measurement is a production system working hand-in-hand with Method-Study to increase productivity which every manager should use. It was introduced in South-East-Asia in 1960's when manufacturing boomed with the foreign investment. However, despite its proven significance functions in productivity measurement and has long history in this region, the literature shows that studies on work measurement practices are very limited. It is an absolute waste if there have been tremendous improvements deployed in the machinery, systems, and tools, but they do not function to their maximum capacity because their interaction with the labor or other factors is not optimized, or if there is poor work measurement to understand the 'productivity-leak-factor' in the operation. This paper shares the research on work measurement-related studies which is carried out in this region and discovers that there is only <10% of manufacturing companies practice work measurement regardless of operations profile, industry types, physical sizes and other factors. It also discusses the key influencing factors and the preliminary findings that uncover the fundamental work measurement facts which reflect the current phenomenon. It is found that much needs to emphasize the consequence of poor work measurement practices and instill the appropriate use of these engineered methods.

Keywords

Work Measurement, Industrial Engineering, Time Studies, Labor productivity performance, ASEAN Manufacturing Practices

1. Introduction

Industrial Engineering plays many key roles in an organization which includes and not limit to business process improvement, building effective measurement systems, integrating organizational systems performance measurements, determining resource plan, and estimating costs. Method Study falls into the category of building effective measurement systems. It studies the steps and works for the task, identifies the unnecessary / excess/ non – optimized movements and eliminates ineffective time as a result of product/ process shortcoming.

Work Measurement is the application of techniques designed to establish the time for a qualified worker to carry out a task at a defined rate of working. It can also be leveraged to compare the time consumed by different methods, and hence to pick the best methods to set challenging and yet achievable standards for continuous improvement.

With the combination of Method Study (to analyze, combine, simplify, eliminate unnecessary movement in order to make the job more economically to do it) and Work Measurement (to evaluate, determine, eliminate ineffective time and set the standard to perform the task), the two work hand in hand to increase the productivity by following the systematic steps and repeat the steps over and over again.

1.1 Introduction of Work Measurement Practices in ASEAN Industries

Work Measurement in primitive forms has been around for hundreds of year, whilst the scientific research in Work Measurement started more than one century ago from the West. Among the famous ones are Frederick Winslow Taylor for his scientific management in the 19th century; Frank and Lillian Gilbreth's motion study research and development of "therbligs" that are based on the manufacturing environment. Subsequently, the concepts and models are included in the university course under the Industrial Engineering during pre-war. Despite there were many scientific research and publications about work measurement, motion and time study in the next few decades, work measurement remained circulated among the Westerners.

1960s was the period where goods industry mushroomed after World War II. Over this period, the expansion of manufacturing boomed in South East Asia with the foreign investment. There were industrial parks established which many large-scale Americans' and Europeans' OEM (Original Equipment Manufacturer) set up their off-shore facilities. The entire economy was expanding, fuelled by large-scale labor workforce transformation from agricultural base to industrial base.

The foreign companies brought in their technical and scientific innovation as well as the production management systems. Work Measurement was one of the production systems introduced for the productivity measures. Some companies set up I.E. (Industrial Engineering) Departments to handle work measurement and other basic I.E. functions such as capacity planning, layout and facilities planning. For the smaller scale companies, instead of appointing a dedicated I.E. department, planning, production, or engineering department was assigned to manage the work measurement related activities. It was not unusual that some companies purely based on estimation and historical records to substitute for work measurement.

1.2 Current Practices in South East Asia Industries

There has been steady and positive growth in the manufacturing sector in the past 5 decades. As a result, there had been a substantial upgrading of the human resource capability, resulting in the development of a range of niches and specialties, particularly in automation.

Nevertheless, the awareness of work measurement impact on productivity performance remains low. The literature shows that studies on work measurement practices in this region are very limited. An informal preliminary data shows that I.E. department is not set up in manufacturing plants. Even if there is I.E. department, its main charter relates to scheduling, capacity and capital planning or for other purposes; whilst for the methods of measuring work, very often, the fastest and least expensive ways (such as estimating and referring to historical data) are used despite of its inconsistency.

2. Need for This Study

After having gone through the literature and preliminary data collection on the Industrial Engineering and work studies actual practices in the manufacturing industries, it has been observed that there are still many benefits to offer for the manufacturing to eliminate the resource waste in the process. It is an absolute waste if there have been tremendous improvements deployed in the machinery, systems, and tools, but they do not function to their maximum capacity because their interaction with the labor is not optimized. To comprehend further about this region Industrial Engineering and work measurement practices, a survey is carried out to collect the facts. The findings will support the research work for the following purposes:

- The impact of work measurement method towards the manufacturing productivity and hence to enable the industries to understand the trend and benefits to set strategic move to unleash the potential.
- To provide guidelines for the industries, especially for the sectors which are 'high' and/or 'semi-high' labor intensive in resource to appropriately measure and set the right standards for labor productivity.
- The guidelines can be used by the institutes as the fundamental and basic Industrial Engineering syllabus to learn the practical way to set standards to collaborate with these region industries' needs. This knowledge learning process will allow the students and practitioners to be able to effectively deploy and perform the work standard setting at workplace appropriately.

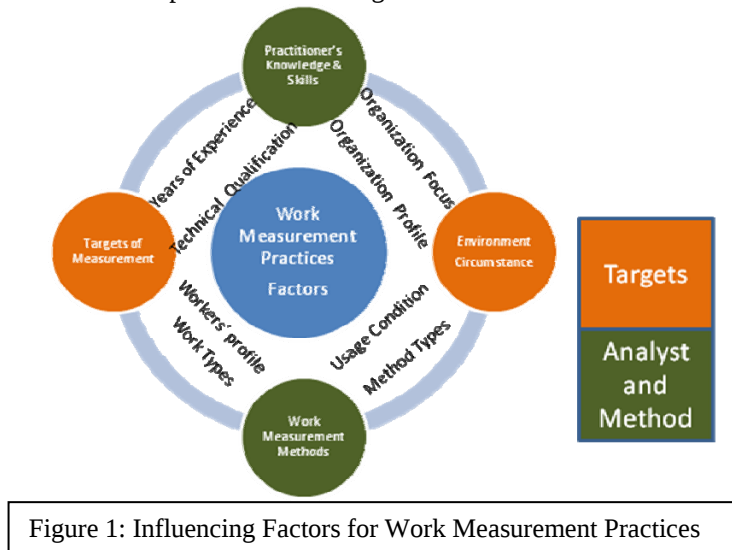
3. The Approach of Data Collection

Surveys have been distributed to 400 manufacturers around the ASEAN. Countries include Malaysia, Singapore, Indonesia, Vietnam, Philippine, Thailand, Brunei, Burma, Laos, and Cambodia. There are no specific company selections criteria in order to widen the range of diversities of service and product type. The questionnaires are written in English and designed in e-survey format and Microsoft Excel for softcopies delivery whilst hardcopies are delivered through postal service or door to door delivery to those in vicinity.

3.1 Factors for Work Measurement Practices

With reference to *Work Measurement in Skilled Labor Environments* and the Industrial Engineering Publication *IE Terminology*, work measurement is "a generic term used to refer to the setting of a time standard by a recognized industrial engineering technique." "While this definition may depict a simplistic image of work measurement, the

process of determining a time standard in a complex labor setting is far from easy. Thus, the survey questions are designed to include all possible influencing factors on the work measurement practice as shown in Figure 1.



There are 2 key components that influence the Work Measurement Practices, i.e. 1) analyst and method to apply 2) the targets of the studies. Each component is further divided to 2 factors. The total four key influencing factors that contribute to the work measurement profile are 1) Practitioner's knowledge: Work measurement is about how humans interact with tools, processes, people, technologies and combinations of them. Knowledge learned in the books seldom suffice to cope up the work measurement work. A practitioner's skill set for analytical reasoning is critical. 2) Environmental circumstances refer to type of working environment. A wafer fabrication plant facility versus garment manufacturer impacts the workplace physical setting, work methods, capability, productivity rate setting, and workforce ratio. 3) To effectively counter measure factors #2, different work measurement methods must be applied. The availability and freedom to use any method is equally important. 4) The targets of measurement is a set of complex raw data. It makes the analysis complicated and hence is an influencing factor.

3.2 Survey Questions Categories and Structures

The questions are sub-divided into five categories to support the four influencing factors:

- Collecting data on the targets: Multiple questions are designed to gather information about the Environment circumstance which are mainly the company's and its workers' profile, the work environment such as whether it is labor intensive or machine oriented, types of raw material used, working method and the operation mode.
- Industrial Engineering resource utilization & application and the types of existing methods used for work measuring: The sub-questions are also aimed to collect information to comprehend the root causes and other influencing factors of not using work measurement and the alternative ways as substitutions.
- Find the influencing factors of the practices and the consequences based on productivity measurement of plan versus actual performance: The influencing factors include and not limit to the practitioners' on job experience, type of technical training received and other influencing factors which impact their practice of work measurement.
- Information collection about the potential correlations of the suitability and the quality of work measurement analysis and other variables.
- Rating of the popularity of the methods available in the market: Users' inputs about the influencing factors to switch to other measuring methods, as well as the opportunity for improvement in general for the work measurement practices.

3.3 The Survey Response

The overall survey response rate is around 41% (165/400) from all countries except Cambodia, Brunei, Burma, Laos, and Cambodia. Despite a good return rate, only 9.3% (37 companies) provide complete or usable information. Out of those, 28 companies (6.8%) report that there are I.E. departments and confirm practicing work measurement.

6.8% seems like a small population; however, there is no track record to testify this % representation in terms of the healthiness or growth of work measurement practices in this region.

4. Result and Discussion

There are a few different aspects observed between the groups of work measurement versus non-work measurement practice companies in the 13 categories of industry sectors from the responded surveys (see Table 1).

Table 1 : Comparison of company profile on work measurement practices			
Key Point #1	Key Point #2	Key Point #3	Key Point #4
Work Measurement Practices	Environment	Workers' Quantity	Workers' Skill set
Electronics Manufacturer			
Wafer Plant			
LED Manufacturer			
Box-build Assembly Plant			
Heavy Tooling Manufacturer			
Petroleum			
Garment Manufacturer			
Chemical Production			
Automobile Manufacturer			
Medical Device Manufacturer			
Finance Organization			
R&D Organization			
Food Processing Industry			
Legend			
All companies in this category practice Work Measurement	Manufacturing facilities	1000 persons and above	50% or more non skilled work
Some companies in this category do not practice or partially practice	Special type of work	Mixture of "1-200" and "1000 & more"	Mixture of skilled and non skilled work
100% companies in this category do not practice Work Measurement	Non Manufacturing work	1-200 persons	100% full skill or specialized work skill required

- Manufacturing versus Non-Manufacturing sector: Refer to key point #1 and key point #2, Work Measurement is used mainly in the manufacturing and production related sectors whilst all the non manufacturing companies do not practice work measurement. In fact, there are other non manufacturing companies in the information technology, warehouse management, logistic, facilities and maintenance providers and many more are invited for the survey but no response received.
- Low versus High head count environment: Key point #3 also draws a conclusion that companies which practice work measurement are staffed with large headcount pool in one working place compared to the non work measurement practice sectors in this study. The office environment and laboratory set up are performed by a small group of fewer than 200 persons.
- Workers' skill-set: As concluded from the table key point #4, normally companies whose work is performed by dedicated individuals with 100% specialized and high-skill do not practice work measurement.
- 100% versus Partial work measurement practice: Multiple companies from each of the sector in Wafer fabrication, Garment, and Automobile manufacturers participate in the survey are 100% using the work measurement systems of any kind (key point#1). Chemical production company is not conclusive due to only one company from this sector participates in this survey.

- For the small manufacturing plants (~200 workers), 1 or 2 types of work measurement tools are used. But, tool types increase proportionally with the worker population. Up to 4-5 types of work measurement methods used in bigger plants.

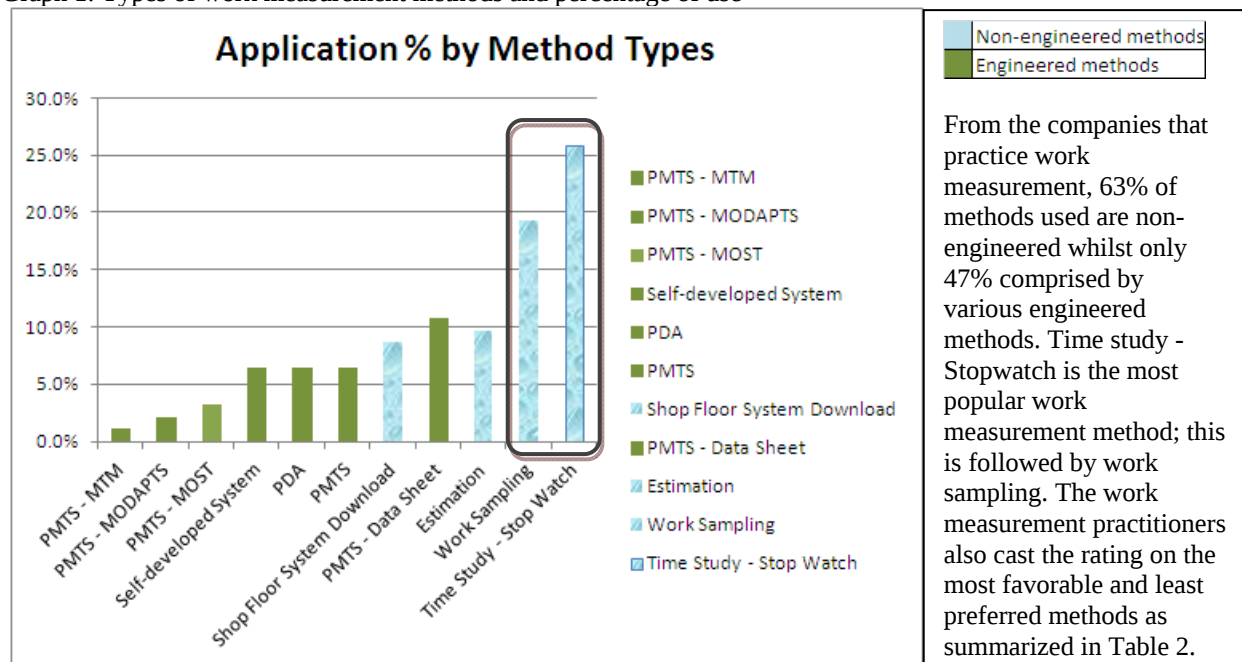
4.1 The Function Work Measurement

The survey results also lead us to comprehend how work measurement data is used. For example, despite ~50% of the companies appoint Industrial Engineer to set the productivity rate (quantity of products produced within a period of time by a person) for their companies, only about 24% of the companies use I.E. or Work measurement method; Referring to the “past record” and “estimations” are more frequently used as main method or cross reference method. In fact, of all the companies in this survey, 100% of them use more than 1 method for work measurement. For the companies with no work measurement practice, the Production Executives follow the past productivity record for productivity rate setting. The combination of these facts can be summarized that using time standards created by historical data in combination with experience seems to have gained a higher confidence over work measurement tools among the manufacturers.

4.2 The Popular Work Measurement Method

Survey shows that work measurement using time study-stopwatch is the most popular method for its users (graph 1). The work measurement practitioners who use other methods (non ‘time study – stopwatch’) also rate ‘time study – stopwatch’ as the most preferred method (table 2 for details)

Graph 1: Types of work measurement methods and percentage of use



Note: MOST – Maynard Operation Sequence Technique
MODAPTS - Modular Arrangement of Predetermined Time Standards
PMTS – Predetermined Motion Time System
MTM – Methods Time Measurement

Table 2: Comparison of preferred work measurement method rated by practitioner

Category of preference	Type of Systems	Group of Work Measurement Users who rate this	Remarks
Least Preferred	MTM	Time Study-Stop Watch, PTS in general, MOST	
Consider Good	Time Study - Stop Watch	Time Study-Stop Watch, PTS in general, MOST, MODAPTS, Estimation, PDA, Self-developed systems	Stop Watch is rated the most popular method among companies that use Stop Watch, Work Sampling, PTS, MOST, and all other methods listed.
Best Method	1) Time Study - Stop Watch 2) Work Sampling	Time Study-Stop Watch, PTS in general, MOST, MODAPTS, Estimation, PDA, Self-developed systems	Time study - Stop Watch remains as the popular one in the category of "Best Method". However, Work Sampling is also popular followed by that.

4.3 Relationship of the Favorable Methods

These are the key points from the survey response of work measurement practitioners' background:

- About 40% of the work measurement practitioners pose the Bachelor or Master Degree in I.E., whilst 24% learned the Work Measurement related subjects through the company internal training program.
- The top 3 Work Measurement courses that the practitioners have taken are Stopwatch, Work Sampling and PMTS (follow the popularity sequence).
- The practitioners have 2 to 5 years of working experience in work measurement.
- They work in a team of 5 persons or more.

The findings aforementioned tend to indicate that the preference is driven from the users' academic background and the peers' interaction where they may provide the technical support to each other with similar background. However, there are additional correlated facts to be addressed.

With reference to *Work Measurement in: Handbook of Manufacturing Engineering*, "The fastest and least expensive way of measuring work is to guess. Very often, one may have little or no information available on which to base a guess. Time standards created by guessing are usually very inaccurate and inconsistent. All they provide is a number, unsupported by the conditions under which the work is being done". The output of this type of time standard determination method is called Non-engineered Time Standards. "Historical data based on experience, estimation, self-reporting, and even stopwatch time studies and work sampling very often fall into this category of non-engineered standards although there are cases when acceptable backup data are produced".

As pointed in section 4.2, 63% of methods used are non-engineered whilst only 47% comprised by various engineered method. The statistic leads to a conclusion that an easy applied system is preferred over an engineered system which practically being established by using an indirect measurement method. In other words, engineered work measurement methods which require more technical knowledge to apply, use more than one direct method and require longer time and steps to generate a number (time standard) are not preferred despite better accuracy, consistent and less drawbacks. This can be a worrying fact that even though there are trained and qualified I.E. workforce, instead of using an engineered technique, an easy and direct method is chosen to determine a manufacturing facilities work measurement analysis. The causes of such scenario are partially discussed in section 4.4.

4.4 Switching of Work Measurement Methods

As discussed in section 4.1, most companies use more than 1 work measurement method as the primary and /or cross reference/supporting function. Among the survey participants, only garment manufacturers completely satisfy with their current method -GSD (General Sewing Data). The survey results (Table 3) also show that it is not easy to switch to other method in a company. For the big corporation, there is company standard which controls / influences the decision. Contradictory, the small firms most concern about cost and available of resource to manage the transition. The least influencing factor is "certification" and this is probably due to the survey target population is the corporate instead of individual whereby company is affordable to pay for the training and certification fees.

Table 3: Influencing Factors rating of switching work measurement type

Factor(s) and rate of influence level	The Most	The Least
Company's preference or standard	14	3
Follow majority staff's expertise	0	1
No or lack of certification	0	9
Constraint in budget , time or resources	2	3
Licensing and consultation fees is too high	1	7
Too many changes to manage to switch method	2	1
Others	1	0

4.5 The Consequence of Poor Use of Engineered Work Measurement Methods

Sections 4.2 to 4.4 share a few clues that there is generally poor use of engineered work measurement methods. The chain effects can be linked to both lack of academic focus to learn work measurement methods in school and the preference from companies. A graduate who is not equipped with the knowledge of engineered work measurement methods is likely to apply only the non-engineered methods in workplace. It requires additional efforts and investment to attend the relevant training as well as practices to master the engineered tools. On the other hand, since there is tremendous time to administer and maintain many time standards and work measurement analysis, companies would rather pick the quick and thrifty non-engineered methods as the preferred measuring methods. However, the impact of setting time standards using non optimized work measurement can be one of the root causes of non optimized use of capacity and resource. It creates a long term and progressive negative impact on the productivity and efficiency. The magnitude of such impact is even more with the operations that involved the interaction of machine and labor.

5. Conclusions

The research at this stage is finding the fundamental work measurement facts in this region despite a few non English speaking countries do not participate. It is a reflection of the current phenomenon. Nevertheless, even though work measurement is critical and important in determining the productivity from academically standard point, it is not a common practice among the industries. Even there are plenty of established work measurement tools available, the preferred and frequently used methods narrowed down to the more traditional and non-engineered methods; for instance time study thru stopwatch and work sampling based on the practitioners' technical training, on job experience and existing company practice. Except for the garment industry, which has already found the best fit method, others in the survey are neither satisfied nor unsatisfied with the present method. Switching of work measurement method is highly driven by company rather than individual's preference, technical relevance or needs. There is no conclusion possibly drawn to the selection of method is based on and well suits the types of industry based on the work nature, work method & cycle time, worker's profile and other relevant factors. It is also not conclusive that the presently used methods contribute to effectively improvise the productivity in this region.

6. Future Work

Data collection has been one of the most challenging steps in this survey, possibly due to local languages barrier in this region and generally the industries are not used to participate in Industrial Engineering related type of research activities. The next phase research will concentrate on the correlation factors of the choice of the labor work/motion study & work measurement methods based on the workplace actual practice through various means. Studies will compare the productivity level versus the work study methods applications based on on-site observations, phone interview and other possible ways with the challenges of language and geographical mobility.

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Solutions(M), First Solar (M), Honeywell Aerospace Avionics, Square, Nokia, Hitachi Chemical, Perusahaan Otomobil Nasional, Pouchen Group, Flextronics Singapore, Tri Quint, KCK Garment, AUO Sunpower, Delphi Automotive System, AMD(M), CPF Public Company, Central Almenario de Tarlac, ProPlanner Asia, and Micron Singapore.

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Biography

Thong Sze Yee started off as an Industrial Engineer in Intel and has been with the manufacturing industry practicing LEAN and Industrial Engineering for 20 years. Ms.Thong has held various managerial positions in Industrial and Manufacturing Engineering, Operation and Project Teams. She is a senior manager managing a team of IE, LEAN and Six Sigma experts in Flextronics since 2007. She holds a B.S. degree in Industrial Engineering from Rochester Institute of Technology (RIT), USA. Presently she is a Doctoral Candidate in Manufacturing Engineering with Unimap, Malaysia. Her enthusiasm in IE and LEAN does not stop at workplace, she loves reading IE technical books, writing technical articles & blog posts, and participating in relevant forums at free time. While enjoying her mentorship role at work, her private life is equally enriched with time spent with her three young children and voluntary work in promoting green environment and animal welfare.

Zuraidah Mohd Zain received her B.Eng. in Materials Science and Engineering from University of Florida, and a PhD from University of Liverpool. She then became worked in Universiti Sains Malaysia, where she later became the University's Quality Program Chairperson, and subsequently, the University's Quality Bureau Coordinator. She helped establish Penang's ISO9000 Support Group, and represented USM in the Penang Skill & Development Corporation (PSDC) Centre of Excellence. She was also a member of the ASEAN University Network-Quality Assurance (AUN-QA), a Resource Person for the World Bank's ISO9000 training courses, as well as for the Asian Institute of Technology (AIT) quality-related programs. In 2002, Zuraidah joined Universiti Malaysia Perlis, where she held numerous offices as such Dean -Centre of Communication Skills & Entrepreneurship, Dean -Academic Management & Internationalisation, Dean -Centre for International Affairs, Dean -School of Manufacturing Engineering, and, presently, Assistant Vice Chancellor (Corporate Communication).

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