

Proceedings The 2<sup>nd</sup> International Conference On Global Optimization and Its Applications 2013  
(ICoGOIA2013)

Avillion Legacy Melaka Hotel, Malaysia 28-29 August 2013

# An Overview of the Development of Digital Water Meter: A Perspective From a Consumer Behavior

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**Abstract**— This study provides an overview of market potential for the development of Digital Water Meter (DWM) in Malacca. The DWM will uphold the strategic plan of the Ministry of Energy, Green Technology and Water (KeTTHA) which is to increase national capability and capacity for innovation in Green Technology development and to enhance Malaysia's competitiveness in Green Technology in the global arena. A descriptive method based on data published in Malacca and abroad served to complete this market survey. This research used quantitative method. A review is made on current water meter, Analog Water Meter. This study conclude that, DWM has good market potential as it n obtain precise and accurate water usage readings, transmit the water reading wirelessly, display unit in Ringgit Malaysia (RM) and measure flow in Cubic meters (m<sup>3</sup>).

**Keywords**— *Development of Digital Water Meter, Analog water meter, green technology*

## I. INTRODUCTION

Malaysia has placed high expectation to ensure that all issues related to the provision of electricity and clean water to the people can be addressed in addition to the success of green technology direction of the country. The Policy of National Green Technology which launched in 2006 is a blue print to set the direction of Malaysia's green technology.

Green technology refers to development and application of products, equipment and systems to protect the environment and the natural environment and minimize or mitigate the negative effects of human activities.

Thus, development of Digital Water Meter (DWM) is one of the government plans to initiate the usage of green technologies. DWM's function is to improvise analog water meter towards intelligent digital water meter. The digital water meter uses a rotary turbine and a gear mechanism to measure the water usage, sending the water meter reading wirelessly and display unit in Ringgit Malaysia (RM) and Cubic Meters (m<sup>3</sup>). DWM is a micro hydro product which emphasis in green technology.

This paper highlights a market research on DWM, specifically focusing on factors influencing consumer behaviour.

## II. DEVELOPMENT OF DIGITAL WATER METER (DWM)

The notion of the development of DWM is to overcome a issues faced by analog water meters. R. Sundram [1] stated that DWM measure and calculates the water usage of the consumers by using the flow sensor, electronic circuits and digital algorithms. This meter is deferred from the analog water meter where it uses the rotary turbine and the gear mechanism to measure the water usage. The importance of DWM is to be considered as a replacement product of the current water utility system in Malaysia.

Figure 1 shows the diagram of the analog water meter and digital water meter. DWM can calculate water flow precisely and transmit the calculated data wirelessly to the terminal unit. Thus, DWM may reduce time taken on water meter reading process. Furthermore, consumer is able to estimate the monthly water usage and the total cost for the month.

Description	Analog Water Meter	Development of Digital Water Meter
Product		
Figure		

Fig 1: Diagram of the meters

## III. CONSUMER BEHAVIOR

Schiffman and Kanuk [2] said consumer behavior focuses on how individuals make decisions to spend their available resources (time, money, effort) on consumption-related items. Additionally, Solomon [3] also defined consumer behavior as the process and activity when the consumers use to evaluate, purchase or dispose goods and services to satisfy their needs.

The paper agrees with two opinions stated above because in order to understand how changes in the market occur, researcher has to collect suitable information and identify relevant facts about buyer behavior before develop and let the product enter the market. This will make an added-value to new product like DWM by identifying critical factors influencing the consumer behavior.

#### A. Factors / Characteristics Influencing Consumer Behaviour

According to Kotler [4], consumer purchase is influenced strongly by cultural, social, personal and psychological characteristics. For the most part, organizations cannot control such factors, but they must take these factors into account.

Abu and Kamarulzman [5] also used the same framework as Kotler in their study on factors affecting consumer behavior. An understanding of these factors is extremely important for a new push strategy product like DWM.

Figure 2 shows a conceptual framework for this study.

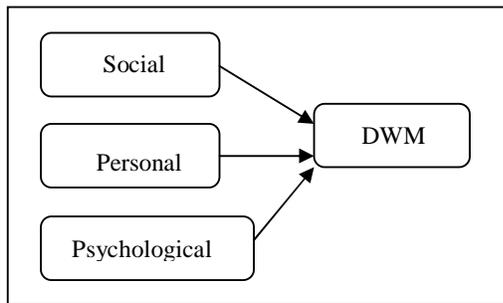


Fig 2: A Conceptual Framework

This research focuses on three main factors which are social factors, personal factors and psychological factors.

##### 1) Social factor

According to [4, 5] consumer's behaviour is influenced by social factors, such as the consumer's small groups, family as well as roles and status.

Reference groups serve as direct (face-to-face) or indirect points of comparison or reference in forming a person's attitudes or behaviour. Marketers try to identify the reference groups of their target markets. Reference groups expose a person to new behaviours and lifestyles, influence the person's attitudes and self-concept, and create pressures to conform that may affect the person's product.

Family is also key influence of the consumer's behaviour. The family is the most important consumer buying organization in society, and it has been researched extensively. According to Schiffman and Kanuk [2] family life-cycle segmentation is based on the premise that individual's formation, growth and final dissolution pass through similar phase in their family. At each phase, the family unit needs and

share different products and services throughout the lifecycle. Each lifecycle may influence the behavior of the consumer.

##### 2) Personal factors

Kotler [4] and Abu and Kamarulzman [5] stated a buyer's characteristics also are influenced by personal characteristics such as the buyer's age and life-cycle stage, occupation, economic situation, lifestyle and personality and self-concept.

Age and life-cycle stage serve as people change their preferences on goods and services throughout their lifetimes. Occupation and economic situation also affects the choices of goods and services bought. Lifestyle is a person's pattern of living as expressed in his or her activities, interest and opinion. Lifestyle concept can help marketers understand changing consumer values and how they affect buying behaviour. Consumers do not just buy product, but they also buy the values and lifestyle those products represent.

Personality refers to the unique psychological characteristics that distinguish a person or a group. Personality is usually described in terms of traits such as self-confidence, dominance, social ability, autonomy, defensiveness, adaptability and aggressiveness. Personality can be useful in analyzing consumer behaviour for certain product or brand choices.

##### 3) Psychological factors

Kotler [4] and Proctor [6] mention a person's buying choices are further influenced by four major psychological factors: motivational perception, learning, belief and attitudes.

According to Schiffman and Kanuk [2], motivation is the driving force within individuals that urges them to action. This driving force is produced by a state of tension, which exists as the result of an unfulfilled need. The specific goals they select and the patterns of action they undertake to achieve their goals are results of individual thinking and learning.

Motivation is a need that is sufficiently pressing to direct the person to seek satisfaction. Given this information it may be possible to gain a competitive advantage in the design and/or marketing of a product.

Perception is the process by which people select, organize, and interpret information to form a meaningful picture of the world. People do not see the same event in exactly the same way.

Learning describes changes in an individual's behaviour arising from experience. Learning occurs through the interplay of drives, stimuli, cues, responses, and reinforcement.

Belief is a descriptive thought that a person holds about something. It may base on knowledge, opinion, or faith and may or may not carry emotional charge. An attitude is a person's consistently favorable or unfavorable evaluations, feelings, and tendencies toward an object or idea.

#### IV. RESEARCH METHODS

In order to determine the exact information needed, quantitative research approach is chosen. For this research, a survey was used by distributing the questionnaire to the respondents. The research was conducted in Malacca. The consumers in Bandaraya Melaka are selected as respondents. A total of 1043 respondents have been selected among the consumer in Bandaraya Melaka. This series of survey has been conducted among UTeM, Universiti Teknologi Mara (UiTM), Majlis Amanah Rakyat (MARA) and Kolej Yayasan Melaka (KYM). The respondents are asked to complete the questionnaires of four sections. A result from the survey has been analyzed and the results are as below:

##### A. Reliability Analysis

According to Sekaran [7], reliability test is testing for consistency and stability. Consistency indicates how the items measuring a concept hang well together as a set. In general, reliabilities less than 0.60 are considered to be poor, those in range 0.70 are acceptable and those are over 0.80 is good. The cronbach alpha of the questionnaires is 0.75 which is acceptable.

##### B. Data Analysis

The highest "Average total bill expense for a month" is RM21-RM30 per month with 264 respondents or 25.30 % have ticks for this answer.

TABLE 1 Average total bill expenses month

Average total bill water expense for a month	Frequency	Percentages (%)
≤ RM 10 per month	117	11.20%
RM 11-20 per month	234	22.40%
RM 21-30 per month	264	25.30%
RM 31-40 per month	179	17.20%
RM 41-50 per month	105	10.10%
≥RM 51 per month	144	13.80%
Total	1043	100.00%

The answer for question "Knowing the amount of water used every day without referring at monthly water bill" have shown that almost 80% of the respondents did not know the amount of water used without referring to the water bill. Two questions, which asked "I support the water saving campaign" and "I support water meter which show the amount that we need to pay in Ringgit Malaysia (RM)" has received a "Strongly Agree" answered from the respondent with 466 respondents or 44.70% and 449 respondents or 43.00%. This shown that the respondent is equally agree with the objective of the Ministry of Energy, Green Technology and Water (KeTTHA) to increase national capability and capacity for

innovation in Green Technology development and to enhance Malaysia's competitiveness in Green Technology globally.

Most of the questions for psychological factors, which is measured by two parameter; motivation and perception were attained "Agree" answered. The questions "I realized about the importance of Green Technology" (590 respondents or 56.60%) has gained the highest respond followed by "I like to use a water meter which is environmental friendly" (524 respondents or 50.20%), "I support wireless meter data collection networks to collect the amount of water usage of customer" (462 respondents or 44.30%), "I satisfied with the current water meter" (443 respondent or 42.50%) and "The value of water use in Ringgit Malaysia (RM) will can help in saving the water" (435 respondents or 41.70%) and lastly is the question "I believe that this DDWM is marketable" (433 respondents or 41.50%). The result has proven that this product is receiving a positive respond from the respondents in Malacca.

Meanwhile, the question "The current water meter reading sometime is not accurate" and "Door-to-door manual meter reading causes disturbance to my privacy" has received "Neutral" and "Disagree" answered with 429 respondents or 41.10% and 346 respondents or 33.20%. However, majority of the respondent (89.8%) agreed that DWM should be used in Malacca as exchange of analog water meter.

##### C. Correlation Analysis

###### 1) Testing Hypotheses

Correlation analysis was used to answer hypotheses in this research. DWM is define by question "I believe that this DDWM is marketable" as dependent variables. Meanwhile, the independent variables are social factors, personal factors and psychological factors. There are three hypotheses that been measured. Since the data uses in social, personal and psychological factors are nominal, the non parametric test has been chosen to test the hypotheses.

H0: There is no relationship between social factors and DDWM.

H1: There is relationship between social factors and DWM.

TABLE 2 Correlation analysis between social factor and DWM

Spearman's rho	Marketable	Correlation Coefficient	Marketable	social_factor
		Sig. (2-tailed)	1.000	.026
		N	1043	1043
	social_factor	Correlation Coefficient	.026	1.000
		Sig. (2-tailed)	.399	.
		N	1043	1043

Table 2 shows that there is no significant relationship between marketable and social factors (Correlation coefficient = 0.026) based on Davis Index (1971).

H0: There is no relationship between personal factors and DWM.

H1: There is relationship between personal factors and DWM.

TABLE 3 Correlation analysis between personal factor and DWM

		Marketable	personal_ factors
Spearman's rho	Marketable	1.000	.119**
	Correlation Coefficient		.000
	Sig. (2-tailed)		.1043
personal_ factors	Marketable	.119**	1.000
	Correlation Coefficient		.000
	Sig. (2-tailed)		.1043
	N	1043	1043

The study founds a significant but weak relationship between marketable and personal factors (Correlation coefficient = 0.119) (Table 3).

Ho: There is no relationship between psychological factors and DWM.

H1: There is relationship between psychological factors and DWM.

TABLE 4 Correlation analysis between psychological factor and DWM

		Marketable	psychologi cal factors
Marketable	Pearson Correlation	1	.493(**)
	Sig. (2-tailed)		.000
	N	1043	1043
psychological_ factors	Pearson Correlation	.493(**)	1
	Sig. (2-tailed)		.000
	N	1043	1043

Table 4 shows the correlation analysis between psychological factor and DWM. It shows that, there is significant average relationship between marketable and psychological factors (Pearson correlation = 0.493) based on Davis Index (1971).

## V. CONCLUSION

This study attempts to analyze factors Influencing Consumer Behaviour. 1043 respondent have been selected among the consumer in "Bandaraya Melaka". This series of survey has been conducted at Universiti Teknikal Malaysia Melaka (UTeM), Universiti Teknologi Mara (UiTM), Majlis Amanah Rakyat (MARA) and Kolej Yayasan Melaka (KYM). Reliability Analysis using Cronbach's Alpha is 0.750 and shows that questionnaires are accepted.

Result from the study shows that from three consumer's behavior factors, only personal and psychological factors play and important roles to influence consumer behaviors to used DWM.

Those factors are based on Kotler model [4] and the highest impact on consumer behaviour is Psychological factors where consumer "perception" contributed the highest values ( $t = 1.833$ ,  $p = 0.067$ ) to the Psychological aspect of consumer and the lowest impact on consumer behaviour is Social factors where consumer "gender" contributed the lowest values ( $t = 1.245$ ,  $p = 0.213$ ) to the Social aspect of consumer. Therefore, it shows that consumer has very positive respond to the DDWM due to very encouraging result that has been collected.

As a conclusion, DWM is accepted in the market based on survey that has been conducted.

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