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# KNOWLEDGE MANAGEMENT IMPLEMENTATION AND OPERATIONAL PERFORMANCE: A CASE STUDY OF APARTMENT BUILDING COMPANIES IN TAIWAN

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Abstract

This study reported here measured knowledge management (KM) implementation for apartment building management and maintenance companies (ABMMCs) in terms of implementation and importance. The importance analysis technique was utilized to analyze KM improvement strategies. A KM performance index value (KMPIA) was used to measure the ability of KM in ABMMCs. The study also explored the relationship between the implementation levels of KM performance, and the overall performance of the ABMMC. The biggest gap in KM cognition among practitioners is "knowledge creation", followed by "knowledge sharing and transfer". Although practitioners strongly agreed with the importance of KM, the implementation of KM was observed not to reflect this regard. "Knowledge creation" and "knowledge sharing and transfer" were the greatest areas of the KM cognition gap. Using the $KMPI_A$ value, Taiwan's ABMMCs performed well, but because of a large variance in knowledge implementation and application, there is room for further growth and improvement. A positive influence relationship between KM implementation level and KMPIA was identified. KM can positively affect the overall performance of Taiwan's ABMMCs.

Keywords: Knowledge management, implementation and importance, apartment building, operation performance

## Introduction

Corporations widely perceive knowledge as a key asset and this have gradually shifted onto the concept of implementing knowledge management (KM). Furthermore, many companies have also adopted a project-based approach to the operations in this regard (Prencipe & Tell, 2001). With the advent of the knowledge-based economy (KBE), this knowledge has become a precious resource needed for individuals or organizations (Brennan, 2000) to acquire. How companies properly handle knowledge has become one of the most critical issues in the field of organizational management (Nonaka & Takeuchi, 1995).

Knowledge management is a series of activities that helps organizations to acquire knowledge from both the internal and external sources. The more broadly such knowledge is applied, the greater its value is (O'Dell & Grayson, 1998; APQC, 2000). Effective KM provides a continuous circulation of information, with knowledge acquired from various sources being systematically organized and stored to ensure easy access throughout an organization, and this also further results in the improvement in the performance as such. Knowledge management activity (KMA) mainly refers to the management of acquired and generated knowledge, which, in turn, entails the acquisition, creation, storage, sharing and transfer of knowledge. Knowledge acquisition (KA) is the collection of existing internal and external information; knowledge creation (KC) is the process of problem-solving and analysis to create new knowledge within an organization; knowledge storage (KSt) entails preserving valuable knowledge for future use; and knowledge sharing and transfer (KSh) is the intentional and unintentional distribution of knowledge throughout an organization (Marquardt, 1996).

The existing research into this sphere offers little guidance or data on effective measurement of KM applications in relation to engineering organizations and this could be considered unusual. That is because researchers in the countries of advanced and strong economies such as the UK and Japan, have also conducted a large amount of research and extended the apartment and building management maintenance industry (ABMMI). In Taiwan, the ABMMI profit margins are very thin and market competition heavily depends on prices, rather than aspects of the quality or the value for money. These low profit margins limit the ability for firms to invest in building improvement activities, which has further resulted in a general industry decline in service quality. Thus, the effective KM can be transferred to improve the service quality and competitiveness most associated with this industry.

## Literature Review

KM is a continual process. Organizations acquire new knowledge through either of the internal innovation or the external resources, and after the process of sorting and storage, this knowledge forms a systematically organized knowledge base for effective dissemination of knowledge within the organization so as further to benefit the work performance of all organization members. According to O'Dell & Grayson (1998) and APQC (2000), KM is a series of activities that

assists organizations in performing activities that they or others do, through improved judgment, to achieve their organizational aim.

Ajmal et al. (2010) judged and decided a range of success factors for KM in firms, using project-based management, and they have found that the most significant predictors of initiative failure are improper incentives and a lack of suitable information systems. In their review of the KM literature, Jennex & Olfman (2005) created a list of potential KM critical success factors. Jennex et al. (2012) further defined a series of dimensions and measures for the assessment of KM success in real-world situations. Although they found that KM implementation increased productivity at both the organizational and individual level factors, they did not discern any measures that directly linked KM to this improvement. More specifically, they found that 20 of their 22 measures were valid, and this part of the findings could extend to the measurement of the actual KM project outcomes. In addition, Jennex (2013) defined KM success and dimensions and the definition as such allowed organizations to effectively evaluate KM successes. They discussed their findings in the context of the management of a nuclear power plant.

Bencsik & Zapletalova (2015) reviewed practical applications of KM systems within 43 firms across Hungary to identify key factors in the successes and failures of KM. Their findings clearly provide important reference for the successful development of KM systems such as for improving existing systems or applying new methods and tools. Zbuchea et al. (2019) provided a descriptive analysis of KM success factors in the context of biotechnology firms in Romania, finding that financial performance was driven by capital flows, productivity, and workforce productivity, and that knowledge - based growth strategies could provide a key competitive advantage. However, this sector still has considerable room for improvement in the KM implementation strategies.

Performance is a measure of the extent to which an organization achieves its goals, including efficiency and effectiveness. Efficiency means doing things in the right way, measured by the ratio of outputs to inputs. Effect means doing the right thing to achieve enterprise aims. Performance measurements appraise the services or programs offered by an organization, and requires discovering or designing standards that faithfully reflect organizational performance.

Del-Rey-Chamorro et al. (2003) proposed a three-tier, eight-step performance measurement framework to create and develop performance measures needed for KM systems. The UK construction industry has gradually adopted the EFQM excellence model, Key Performance Index (KPI) and Balance Score Card (BSC) to measure performance (Bassion et al. 2004).

## The KM Performance Index

Organizations continually acquire and generate new knowledge, but the expansion of KM performance will eventually reach an upper limit. In the initial stages of knowledge management architecture (KMA) implementation, benefits are rela-

tively small. The impact of KMA accelerates in later stages, but the rate of improvement eventually tapers off (Lee et al. 2005). The benefits of implementing KMA can be expressed via the knowledge management performance index (KMPI) (= $1/(1+e^{KCPt})$). In the formula, KCP is the product of the relative weight of the eigenvalue (RWE) and the average factor value (AFV) of each stage, as shown in Eq. 1.

$$KCP = RWEi \times AFVi \quad (1)$$

where i is the KMP of the activity in various stages.

According to Peffers & Dos Santos (1996), corporate investments in information technology (IT) do not show a fixed rate of growth over time. In addition, IT investments believed to yield benefits will also be adopted by competitors. Consequently, adopting new technologies provides the limitation on the improvements in relation to the competitive advantage. Based on the three linear relational analyses proposed by Peffers & Dos Santos (1996), the upper linear growth relationship with an upper limit is the most consistent with a company's actual situation. Therefore, while re-investing in equipment or technology will provide benefits over time, such benefits suffer from a decreasing return on investment. At the outset, benefits are realized slowly because of the learning period required to integrate new technologies into a firm's practices. However, following this stage, benefits accrue rapidly up to a point at which growth gradually stabilizes.

Lee et al. (2005) assumed that the benefits of KMA would grow, following the logistic model S-curve, and KMP was developed and used as research methods and indicators accordingly. By referring to Peffers & Dos Santos (1996) and Lee et al. (2005), the present study suggests that implementing KMA would further require firms to invest in other related technology, equipment and corresponding management procedures. Based on the concept proposed by Lee et al. (2005), we also developed a knowledge management performance index ($KMPI_A$) for assessing apartment and building management maintenance companies' (ABMMC's) KM performance. The paper assumes that a good Knowledge Circulation Process ($KCP_A$) will improve a firm's $KMPI_A$ and organizational performance.

According to Lee et al. (2005), the benefits of implementing KM at time (*t*) can be given by the proportion of $KMPI_{A,t-1}$ and $KCP_A$ (where $KCP_A$ is subject to a maximum value of 1). This study proposed a four-stage $KCP_{A,t}$ framework as shown in Eq. 2. $KMPI_A$ indicators and question content were developed using Eq. 3. After a sample questionnaire was collected, $KCP_A$ and $KMPI_A$ were calculated using these equations. This study sought to determine whether KM performance indicators could not only measure the level of organizational knowledge, but also directly or indirectly determine operational performance. Following a review of the connected literature, this study uses the hypothesis that actively implementing KMA should generate useful organizational knowledge, enhancing $KMPI_A$ and contributing to improved operational performance of ABMMCs.

$KCP_{Bit} = RWE_{KA} * AFV_{KA} + RWE_{KC} * AFV_{KC} + RWE_{KSt} * AFV_{KSt} + RWE_{KSh} * AFV_{KSh}$ QUOTE

B,t = KA KA + KC KC + KSt KSt

+ KSh KSh (2)

$KMPI_{A,t} = 1/(1+ e^{KCP}_{A,t}$ QUOTE

B,t = KA KA + KC KC + KSt KSt

+ KSh KSh ) (3)

If true, the above hypothesis concerning the KMPI of the apartment building management and maintenance industry should be able to measure the status of organizational knowledge, and directly or indirectly indicate its operational performance. Also, with regard to the existing literature on the topic, the active management of apartment building management and maintenance services through KMA should produce good organizational knowledge, which would also increase $KMPI_A$, and help the industry improve operational performance. The two formal research hypotheses posed are as follows:

H1: KM implementation level (KMIL) is positively correlated with financial information, internal operations, customer relations, and learning growth.

H2: KMPIA is positively correlated with financial information, internal operations, customer relations, and learning growth.

## Data Collection and Analysis

### *Data reliability and validity analysis*

A questionnaire was developed and divided into four sections: (1) Basic Information, (2) KMA Implementation Level, (3) KMA Importance Level, and (4) Operational Performance Conformance Level. The survey questionnaire was reviewed and revised by several experienced survey practitioners before being distributed to 280 ABMMC businesses in central Taiwan. A hundred and eighty-one documents were returned (64.6% return rate) and of those, 122 were valid (67.4% valid rate). The Cronbach's α value for each of the four stages exceeded 0.90, indicating good internal consistency and reliability. The Cronbach's α values of the RLE and ALI of the KMA for each stages exceeded 0.85 and 0.9, respectively. Expert/construct validity were also used to assess scale validity.

The initial KM assessment questionnaire was designed with reference to previous studies including Marquardt (1996), Cheng (2002), and Wang (2011). Experienced ABMMC practitioners were invited to evaluate the suitability and attributes of the questionnaire and to recommend modifications. Factor Analysis is often used to determine whether a scale is constructive (Kaiser, 1974). This study first used the

Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy to assess the suitability of the questionnaire for factor analysis. The KMO for each scale item exceeded 0.8 indicating that all the questions posed were suitable for factor analysis.

*Importance Performance Analysis of KMA*

Survey questions were posed using a seven-point Likert scale. Table 1 summarizes the cognition difference of mean level of importance (MLI) and mean level of realization (MLR) of various stages of KMA among practitioners. Concerns among ABMMC practitioners were (in descending order) KC, KSh, KSt, and KA. Among the four stages, KA showed the largest difference. KA had the smallest difference between MLR and MLI (1.88%) while KC had the largest difference (4.55%). KA had the smallest MLI (5.42) but the largest MLR (5.32). The overall mean MLR of KA was slightly lower than that of MLR, while the MLI of KA was the largest (5.51). This suggests that practitioners may underestimate the importance of KMA. In addition, the overall mean MLR values of KSt and KS were all lower than the overall mean MLR (5.28), with respective MLI values of 5.44 and 5.48. In terms of practitioner awareness, the MLR of KMA was lower than the MLI of KMA. This indicates there is an awareness gap in terms of KM's MLI and MLR.

Table 1. Summary of LI and LR for the various KMA stages

| KMA | MLI | MLR | Difference between MLR and MLI | |
|---|---|---|---|---|
| | | | Total Amount | Percentage |
| KA | 5.42 | 5.32 | -0.10 | -1.88% |
| KC | 5.51 | 5.27 | -0.24 | -4.55% |
| KSt | 5.44 | 5.25 | -0.19 | -3.62% |
| KSh | 5.48 | 5.27 | -0.21 | -3.98% |
| Overall Mean | 5.46 | 5.28 | -0.18 | -3.41% |

Importance Performance Analysis (IPA) was used to identify potential improvements for KM implementation. However, the "performance" aspect of the original IPA (Martilla & James 1977) was replaced in this study with "realization" as this is more in accordance with the objectives of the study. The two-dimensional IPA in this study has "realization" on the x-axis and "importance" on the y-axis to form four quadrants to create suggestion for decision making by ABMM practitioners. Quadrant I (High Importance/High Realization) is labeled *Keep up the good work*. These attributes represent the organization's key strengths. Quadrant II (High Importance/Low Realization) is labeled *Concentrate Here*, and includes high priority areas for improvement. Quadrant III (Low Importance/Low Realization) is labeled *Low Priority*, and includes attributes which pose no real threat or opportunity. Quadrant IV (Low Importance/High Realization) is labeled *Possible Overkill*, and includes the attributes that currently receive too much emphasis within the organization along with the tie up resources considered possibly to be better used

elsewhere.

Kale & Karaman (2012) used a diagnostic model to explore the practical aspects of KM in the construction industry. They used the IPA and CPA matrices to diagnose the use of knowledge inside and outside the company to assess the overall importance and performance of KM. Based on Kale & Karaman (2012), this study aimed to explore the KM implementation of ABMMCs in Taiwan. The intersection in the IPA was made using the MLI at 5.46 and the MLR 5.28. Of ABMMC's KMA, both KC and KSh are situated in Quadrant II (Concentrate Here), meaning that industry practitioners realize the value of this knowledge to the company's competitiveness, and so further improvement efforts should be done and concentrated here. This also validates the formula ($KM= (P+K)^3$) proposed by Davenport & Prusak (1998). Whenever knowledge owners share their knowledge, they not only assist the knowledge recipients, but also help to create new knowledge, and so this enhances the value of the knowledge within the organization. In this case, KM applications are of much importance to enterprises.

None of the four KMAs are situated in Quadrant I (Keep Up the Good Work). KSt is situated in Quadrant III (Low Importance/Low Realization), both have low MLI and MLR values. For these ABMM practitioners, Kst is not currently important and poses no threat to the organization, possibly because these operational aspects have already been integrated into daily operations. KA is situated in quadrant IV (Possible Overkill), which indicates that practitioners have a low awareness of LI but have good LR. This means that present efforts on KA in this quadrant are exaggerated, and practitioners should consider allocating resources (i.e., money, effort, time) elsewhere, especially to items in the Concentrate Here quadrant. In other words, the internal process of configuration and management practices should be adjusted to avoid excessive resource investment in this KMA.

In response to the advances in information technology (IT), many companies are now more concerned with the acquisition of value-based knowledge to leverage internal intangible capital and improve their competition. KM is a series of dynamic activities, which should be coordinated to optimize the value of KM. Therefore, the ABMMCs should begin from KA, and allocate internal resources appropriately on this basis.

### *KMA Performance Indicator*

The study used Principal Component Analysis (PCA) to extract the eigenvector of variables within each stage. A principal component with an eigenvalue greater than 1 was selected as the primary eigenvector for the variable. The eigenvalue is also seen as having the best explanatory ability in terms of expressing each question within a stage.

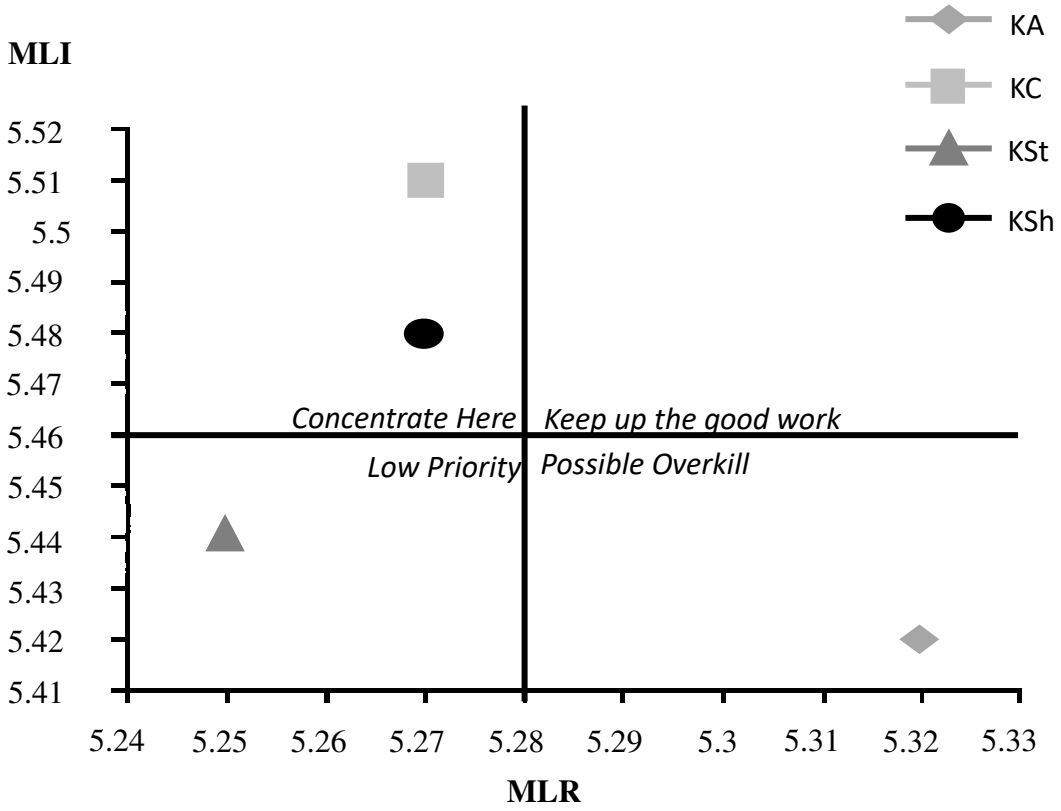


Figure 1 Importance - Performance Analysis of ABMMCs Regarding KA, KC, KSt, and KSh

Based on the KMA defined by the study, as shown in Table 2, the first principal component of each stage was selected for the four stages. The KMLR score for the questionnaire sample is translated into seven grades (each an integer between -3 and 3). The value of *KMPI* will thus be evenly distributed, highlighting performance differences between the ABMMCs. For example, scores of 7, 6, 5, 4, and 3 of LR will be respectively translated into 3, 2, 1, 0, and -1. The AFV of the LR of each stage can be calculated by integrating the converted value and the mean value of each stage, as shown in Table 3. The $KCP_A$ of each company can be calculated by adding up the value of RWI*AFV for a given company. Following that, the $KMPI_A$ of each company can be calculated by Eq. (2). The value $KMPI_A$ shows the performance for realizing KMA. The greater the value of the numerical conversion is, the stronger the KM capacity is. Thus, this reveals a company with good KM capability, and vice-versa.

By referring to Table 3, the average $KCP_A$ is 1.25, indicating that most ABMMCs are able to implement KM, although there is still a room for improvement. $KMPI_A$ conforms to the

time-dependent S-type logistic curve, whose performance index ranges between 0 and 1. The higher the $KMPI_A$ value, the better the company's KM performance during a specific period, and the better the KMA effects. Results show that the average performance indicator score for the eight sample companies was 0.7680, with a high of 0.8569 and low of 0.5349, showing that there was a considerable difference in terms of KM application proficiency. By referring to Table 3, the distribution of $KMPI_A$ for the ABMMC is quite concentrated. The KM capacity of the ABMMCs is clearly shown. Comparing KM capacities across different industries would be a valuable future research topic. Whenever a company's internal KMPI efficiency is improved, $KMPI_A$ will increase along the S-type logistic curve. Thus, the company's operating performance will increase with its KM capacity.

Table 2 Stage eigenvalue and corresponding RWE

| KMA | Eigenvalue (1) | Explained Variation (2) | RWE (3)=(1)*(2) |
|---|---|---|---|
| KA | 3.956 | 56.51% | 0.22 |
| KC | 4.988 | 62.35% | 0.28 |
| KSt | 4.525 | 64.64% | 0.25 |
| KSh | 4.413 | 73.55% | 0.25 |
| Total | 17.822 | | 1.00 |

Table 3 Summary of the $KCP_A$ and $KMPI_A$ for sample companies

| Company | KA | KC | KSt | KSh | $KCP_A$ Σ(RWE*AFV) | $KMPI_A$ [1/(1+ $e^{KCP_{A,t}}$ QUOTE B,t = KA KA + KC KC + KSt KSt + KSh K Sh )] |
|---|---|---|---|---|---|---|

| | | | | | | |
|---|---|---|---|---|---|---|
| A | 1.45 | 1.29 | 1.40 | 1.41 | 1.38 | 0.7989 |
| B | 1.69 | 1.57 | 1.29 | 1.47 | 1.50 | 0.8175 |
| C | 1.15 | 1.26 | 1.19 | 1.10 | 1.18 | 0.7649 |
| D | 1.38 | 1.50 | 1.62 | 1.42 | 1.48 | 0.8145 |
| E | 1.18 | 1.16 | 1.09 | 1.12 | 1.14 | 0.7576 |
| F | 1.43 | 1.47 | 1.29 | 1.33 | 1.38 | 0.7989 |
| G | 0.10 | 0.16 | 0.12 | 0.19 | 0.14 | 0.5349 |
| H | 1.90 | 1.74 | 1.67 | 1.85 | 1.79 | 0.8569 |
| Average | | | | | 1.25 | 0.7680 |

*Difference analysis of background*

This study uses an independent sample t-test to examine differences between the respondents (i.e., gender, number of years of service, and education level), and the difference between the number of years of service and education degree was determined by One-way ANOVA.

1. Gender differences in KM performance

Based on the means, t-value, and p-value of KMA RL, none of the four dimensions showed significant differences based on gender. Thus, gender factor does not have an impact on KA, KC¸ KSt, or KSh. In other words, gender factor is judged not to influence the realization degree of KA, KS, KC, or KSt.

2. Difference between years in service and KMRL

As illustrated in Table 4, the KSt dimension showed no significant difference (F= 1.733, p= 0.147). However, the other three dimensions, KA (F= 3.004, p= 0.021), KC (F= 2.990, p= 0.022) and KS (F= 2.949, p= 0.023), all showed significant difference. This implies the duration of a particular position influences the realization degrees of KS, KC, and KSt. LSD(L). Post-comparisons were performed on dimensions with significant differences (KS, KC, and KSt) and a significant difference was found in terms of the degree of the execution of the categories of different years of service. Tables 4 and 5 show a significant difference in the execution of KS, KC, and KSt, between employees with 2-3 years of service and those with 10 or more years. Although employees of 2-3 years' duration of service have a certain understanding of the company's internal knowledge handling process, because of their shorter tenure, they still need to familiarize themselves further with the full range of professional knowledge and procedures. Consequently, their willingness to learn is higher than others, resulting in better implementation of KS, KC, and KSt. In this case, more recent hires can use this knowledge to enhance their relevant professional skills. On the other hand, personnel of more than 10 years' duration of service have greater operational expertise, experience and familiarity, and thus are more willing to implement KMA.

3. An analysis of the difference between education level and KMRL

Education level is divided into four categories from junior high school and below to graduate school, but is found to not significantly impact the degree of KM implementation dimensions KA, KC, KSh, and KSt. The degree of KMA

Table 4 Difference between service years and KMRL

| Dimension | | Year | No. | Means | F-value | P-value |
|---|---|---|---|---|---|---|
| KMRL | KA | 2-3 | 48 | 5.4167 | 3.004 | 0.021 |
| | | 4-5 | 25 | 4.9371 | | |
| | | 6-7 | 22 | 5.2857 | | |
| | | 8-9 | 9 | 5.0635 | | |
| | | >10 | 18 | 5.7460 | | |
| | KC | 2-3 | 48 | 5.3932 | 2.990 | 0.022 |
| | | 4-5 | 25 | 4.9100 | | |
| | | 6-7 | 22 | 5.2386 | | |
| | | 8-9 | 9 | 4.9444 | | |
| | | >10 | 18 | 5.6319 | | |
| | KSt | 2-3 | 48 | 5.3661 | 2.949 | 0.023 |
| | | 4-5 | 25 | 4.8914 | | |
| | | 6-7 | 22 | 5.1558 | | |
| | | 8-9 | 9 | 5.0000 | | |
| | | >10 | 18 | 5.6508 | | |
| | KSh | 2-3 | 48 | 5.3507 | 1.733 | 0.147 |
| | | 4-5 | 25 | 5.0467 | | |
| | | 6-7 | 22 | 5.2803 | | |
| | | 8-9 | 9 | 4.7593 | | |
| | | >10 | 18 | 5.5833 | | |

implementation is mainly determined by external factors, such as a company reward system, regulation or departmental atmosphere.

*KMRL and Operational Performance*
*Correlation between KMRL and Operational Performance*

This study used the Pearson correlation coefficient to explore the correlation between KMRL (KS, KC, KSt, KSh) and management performance (FI, IO, CR, & LG) of the sample ABMMCs. A high correlation indicates a positive correlation between KMRL and operational performance improvement. Table 5 shows that KMRL had a significant and positive correlation with operational performance. KMRL plays an important role in a company's operational performance. The positive degree of KMRL affects the performance of the company's financial information, internal operations, customer relations and learning growth. KMIR and FI had a high degree of positive correlation ($r= 0.645$, $p<0.01$). Whenever an ABMMC increased KMRL, the company's FI increased, and vice versa. KMRL and IO also had a highly positive correlation ($r= 0.623$, $p<0.01$). Thus, the higher the ABMMC's KMRL is, the higher the company's IO performance gets.

The correlation between KMRL and CR showed a highly positive correlation ($r= 0.657$, $p <0.01$). This indicates the following: the better the ABMMC's KMRL is, the better the company's CR performance becomes. Finally, the correlation between KMRL and LG was

also highly positive (= 0.658, p <0.01); i.e. the higher the KMRL is, the higher the company's LG performance becomes. However, the LG performance falls with KMRL. Combining the above results shows that the implementation of KMA can positively affect ABMMC operational performance and companies should encourage KMA. KM should also be used and circulated to promote a company's IO performance.

Table 5. Pearson correlation analysis of KMRL

| Dimension | | KMRL | Financial information (FI) | Internal operations (IO) | Customer relations (CR) | Learning growth (LG) |
|---|---|---|---|---|---|---|
| KMRL | Pearson | 1 | | | | |
| | Significance | | | | | |
| Financial information | Pearson | .645** | 1 | | | |
| | Significance | .000 | | | | |
| Internal operations | Pearson | .623** | .700** | 1 | | |
| | Significance | .000 | .000 | | | |
| Customer relations | Pearson | .657** | .771** | .848** | 1 | |
| | Significance | .000 | .000 | .000 | | |
| Learning growth | Pearson | .658** | .778** | .757** | .825** | 1 |
| | Significance | .000 | .000 | .000 | .000 | |

*Regression Analysis of $KMRL_A$ and Operational Performance*

In this section, a regression analysis was used to predict the effects of the four dimensions based on $KMRL_A$. Table 6 shows factors' $KMRL_A$ and its regression coefficients, which indicated positive significant differences. This implies a company's $KMRL_A$ value significantly affects its overall operational performance.

Table 6 Regression analysis results of $KMRL_A$ and FI, IO, CR, and LG

| Model | R | $R^2$ | Adjusted $R^2$ |
|---|---|---|---|
| 1 | .645[a] | .416 | .411 |
| 2 | .623[a] | .388 | .383 |
| 3 | .675[a] | .432 | .427 |
| 4 | .658[a] | .433 | .428 |

a. Predictor (Constant): Realization level; b. Dependent variable: Model 1- FI, Model 2- IO, Model 3- CR, and Model 4- LG

| Model | | U.C. | | S.C. | t value | Sig. |
|---|---|---|---|---|---|---|
| | | Estimated B | S.E. | β distr. | | |
| 1 | (Constant) | .842 | .501 | | 1.682 | .095 |
| | $KMRL_A$ | .868 | .094 | .645 | 9.248 | .000 |
| 2 | (Constant) | 1.228 | .492 | | 2.495 | .014 |

| | | | | | | |
|---|---|---|---|---|---|---|
| | $KMRL_A$ | .805 | .092 | .623 | 8.725 | .000 |
| 3 | (Constant) | 1.048 | .481 | | 2.179 | .031 |
| | $KMRL_A$ | .862 | .090 | .657 | 9.551 | .000 |
| 4 | (Constant) | 1.143 | .461 | | 2.480 | .015 |
| | $KMRL_A$ | .826 | .086 | .658 | 9.566 | .000 |
| a. Dependent variable: Model 1- FI, Model 2- IO, Model 3- CR, and Model 4- LG | | | | | | |

Note: UC: Unstandardized Coefficient, SC: Standardized Coefficient

*Relationship of $KMPL_A$ and Operational Performance*

*Correlation between $KMPL_A$ and Operational Performance*

The study used the Pearson correlation coefficient to determine correlations between KMPI (KS, KC, KSt, KSh) and operational performance (FI, IO, CR, & LG) of the ABMMCs. A high correlation indicates that the proposed hypothesis is supported. Table 7 shows that $KMPI_A$ had a significant and positive correlation with operational performance. The degree of $KMPI_A$ affected the company's FI, IO, CR, and LG performance. $KMPI_A$ and FI showed strongly positive correlation (r = 0.902, p <0.00). Thus, as PMC increases $KMPI_A$, the company's FI will increase, and vice versa. Meanwhile, KMPI and IO had a highly positive correlation (r = 0.919, p <0.01). $KMPI_A$ and CR showed a highly positive correlation (r = 0.951, p <0.01). Finally, the correlation between $KMPI_A$ and LG was also strong and positive (= 0.929, p <0.01). The above results show that KMA implementation could positively affect ABMMC operational performance. Thus, companies should urge KMA, and KM should also be promoted as it may improve IO performance.

Table 7. Pearson Correlation Analysis Result of $KMPI_A$ and Operational Performance

| Dimension | | KMPI | Financial information (FI) | Internal operations (IO) | Customer relations (CR) | Learning growth (LG) |
|---|---|---|---|---|---|---|
| KMPI | Pearson | 1 | | | | |
| | Significance | | | | | |
| Financial information | Pearson | .902** | 1 | | | |
| | Significance | .000 | | | | |
| Internal operations | Pearson | .919** | .943** | 1 | | |
| | Significance | .000 | .000 | | | |
| Customer relations | Pearson | .951** | .923** | .931** | 1 | |
| | Significance | .000 | .000 | .000 | | |
| Learning growth | Pearson | .929** | .976** | .946** | .938** | 1 |
| | Significance | .000 | .000 | .000 | .000 | |

*Regression Analysis of $KMPI_A$ and Operational Performance*

A simple regression analysis was used to explore the predictive power of $KMPI_A$ on FI, IO, CR, & LG. In Table 8, $KMPI_A$ and the dimension regression coefficients were all significant and positive. A company's $KMPI_A$ value significantly affects overall operational performance. Finally, correlation and regression analyses were performed to measures the impact of $KMPI_A$ and $KMPI_A$ on the operational performance dimensions. Based on this analysis, the proposed hypotheses were supported.

Table 8 Regression analysis results of $KMPI_A$ and FI, IO, CR, and LG

| Model | R | $R^2$ | Adjusted $R^2$ |
|---|---|---|---|
| 1 | .902[a] | .814 | .783 |
| 2 | .919[a] | .845 | .819 |
| 3 | .954[a] | .904 | .888 |
| 4 | .929[a] | .863 | .840 |

a. Predictor (Constant): Performance indicator; b. Dependent variable: Model 1-FI, Model 2- IO, Model 3- CR, Model 4- LG

| Model | | U.C. | | S.C. | t value | Sig. |
|---|---|---|---|---|---|---|
| | | Estimated B | S.E. | β distr. | | |
| 1 | (Constant) | 1.406 | .781 | | 1.799 | .122 |
| | $KMRI_A$ | 5.178 | 1.010 | .902 | 5.127 | .002 |
| 2 | (Constant) | 1.873 | .632 | | 2.966 | .025 |
| | $KMPI_A$ | 4.673 | .816 | .919 | 5.724 | .001 |
| 3 | (Constant) | 2.155 | .459 | | 4.698 | .003 |
| | $KMPI_A$ | 4.459 | .593 | .951 | 7.519 | .000 |
| 4 | (Constant) | 1.835 | .598 | | 3.068 | .022 |
| | $KMPI_A$ | 4.754 | .773 | .929 | 6.149 | .001 |

a. Dependent variable: Model 1- FI, Model 2- IO, Model 3- CR, and Model 4- LG

## Conclusions

In order to cope with fierce market competition in Taiwan, ABMMCs must effectively apply the knowledge as such to improve their service quality. This study investigated the relationship between KM and operational performance in ABMMCs to provide the basis for KM implementation and support improvements in operating performance for ABMMCs through a four stage KM process. This promotes organizational goals and improves organizational value. Several analysis tools were utilized to meet the research objectives and the major findings were including:

1. Differences in relation to KM ability

KM performance has an overall average of $KMPI_A$ 0.7680, with a high of 0.8569 and a low of 0.5349. There exists an awareness gap among ABMMC practitioners in terms of KM realization and importance.

2. Key KMA factors

The study performs a 2-dimensional KM IPA from the standpoints of LR and LI. Management strategies are proposed

in accordance with the following four status categories: (1) *Keep Up the Good Work*; (2) *Concentrate Here;*(3) *Low Priority*; and (4) *Possible Overkill*. Regarding KMA, both KC and KST are situated in *Concentrate Here*, indicating that ABMMC practitioners ought to focus on these two. KA is situated in *Possible Overkill*, showing that practitioners should reallocate KMA resources to other tasks.

3. KMRL observed to differ significantly with employees' service duration

Years of service are found to have a significant impact on KA, KC, and KSt. Staff of 2-3 years' duration are outperformed by those of 10 years' work experience or more. This may be due to their relative newness to the industry, but their increased willingness and enthusiasm increases their professional ability. Employees of more than 10 years' duration of service showed better KM implementation, possibly because they occupy management positions.

4. A positive impact on operational performance in relation to KM

KMRL and KM both exhibited a significant positive impact on the four operational performance dimensions (FI, IO, CR, & LG), and the regression coefficients were all positive. Thus, active KMA positively influences the four operational performance dimensions. The higher an ABMMC's KMRL value is, the better its operational performance becomes. KM also positively affects ABMMC's operational performance.

Several aspects exposed by this study might assume a greater role in this field if they are further investigated for future development. First of all, this study collected data from ABMMC practitioners regarding KM's low priority (LR and LR), and operational performance, and no distinction was made between the awareness of high and low-level practitioners. In this case, future studies could also explore the awareness of high-level managers to clarify if there is a knowledge gap. Secondly, although many factors affect KM performance, this study only focused on the status of ABMMCs from the viewpoint of KMLR, KMLI, and operational performance. Further study may examine organizational type, culture, learning, or some combination of these analytical approaches.

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