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THE INFLUENCES OF TRANSFORMATIONAL LEADERSHIP ON COLLECTIVE EFFICACY: THE MODERATING ROLE OF PERCEIVED ORGANIZATIONAL SUPPORT

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Abstract

This study examined the relationship between transformational leadership and collective efficacy. We took data from 305 employees representing 55 teams. We studied the role of transformational leadership behavior on collective efficacy of employees. Besides, the study investigated the moderating role of perceived organizational support in the relationship between transformational leadership behavior and collective efficacy. Our analysis was focusing on team level. Thus, the finding contributes for the dearth team level leadership process literature. Moreover, the result revealed that transformational leadership has positive and significant impact on collective efficacy. The finding further exposed that perceived organizational support moderated the relationship between transformational leadership behavior and collective efficacy positively. Finally, the study addressed some theoretical and practical implications.

Keywords: transformational leadership, perceived organizational support, collective efficacy

Introduction

Transformational leadership (TFL) was found a better predictor of positive attitudes, motivation and leader effectiveness than other leadership style such as transactional and laissez-faire (Judge & Piccolo, 2004). It is considered as the most important organizational asset

(García-Morales, Lloréns-Montes, & Verdú-Jover, 2008) influencing different outcomes for example self-efficacy (Ng, 2017), performance (Gang, Oh, Courtright, & Colbert, 2011), collective identity and empowerment (Conger, Kanungo, & Menon, 2000).

Although there exists several established relations between TFL and different performance outcomes, studies mainly focused on individual-level outcomes (Chou, 2014). A recent meta-analysis review on transformational leadership and performance outcomes revealed the lack of team level studies. From 389 empirical studies, 79% of the studies examined at the individual level 11% at the team or unit level and 10% at the organization level (Ng, 2017). Given the importance of team in the organization and relatively fewer studies, we argued that examining the influence of transformational leadership on collective efficacy is worthwhile (Chou, Lin, Chang, & Chuang, 2013).

On the other hand, despite the suggestion to include contextual factors in the relationship between transformational leadership and follower outcomes (Herold, Fedor, & Caldwell, 2007; Wang & Rode, 2010), studies have implicitly presumed the effects of transformational leadership on different outcomes as context-free (Chou, 2014; Wang & Howell, 2012). Comparatively, quite limited studies examined the organizational context as a moderator variable. Contextual variables have an important role in facilitating the relationship between transformational leadership and outcome variables either positively or negatively (Yousef, 2000). Hence, this study examined perceived organizational support as a contextual variable.

The purpose of this study is primarily to address the lack of team level studies. Particularly the study examined relation between TFL behavior and collective efficacy. Moreover, the study investigated the moderating role of perceived organizational support in the relationship between TFL behavior and collective efficacy. The framework for this study was founded on social exchange theory. Social exchange theory describes the exchange relationship between leaders and followers. Thus, with regard to this study, the TFL behavior of leaders provided to the followers in exchange for the collective efficacy of employees. Figure 1 depicted the framework for the study.

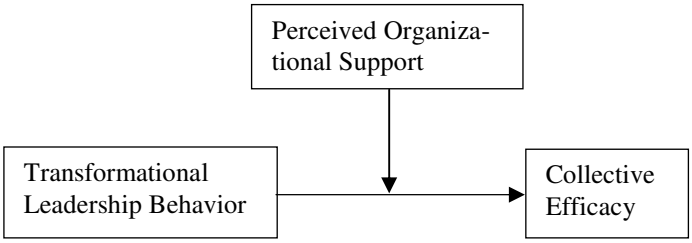

Figure 1. A proposed study framework

Literature Review

Transformational Leadership

Researchers commonly used the prominent definition of transformational leadership (Bass, 1985) which refers the effect of leader behaviors on followers (Yammarino, Dionne, Chun, & Dansereau, 2005). Unlike transactional leadership arguing on the economic exchange process to motivate follower agreement to meet the expected requirement, TFL by far influences the process that motivates followers by encouraging them to go beyond the expected requirement and their self-interest (Bass, 1985; Yammarino et al., 2005).

Due to its positive relation with important organizational outcomes, transformational leadership is considered as the most important organizational asset (García-Morales et al., 2008) and becomes the focus of leadership studies than other leadership styles such as transactional and laissez-faire (Judge & Piccolo, 2004).

Transformational leadership behaviors include individualized consideration, intellectual stimulation, inspirational motivation, and idealized influence (Bass, 1985; Bass & Avolio, 1994). Idealized influence refers when transformational leaders act as a role model to their subordinates such that the followers identify themselves to high level of moral and enthusiasm to fulfill the demands of leader whom they respect, admire and trust (Bass, 1985). Inspirational motivation highlights leaders' motivation and inspiration of followers by giving self-worth for their contribution and setting challenges to their followers' (Bass & Avolio, 1994). Intellectual stimulation is encouraging followers' to do tasks in a distinct way by being innovative and creative. Individualized consideration refers giving special attention to the needs of every individual follower for their achievement and personal growth (Bass, 1985).

Collective Efficacy

Employees' confidence is the key factor for performance because those with higher efficacy are likely to achieve higher performance (Ng, 2017). Unlike individual level self-efficacy, collective efficacy is a group level construct (Katz-Navon & Erez, 2005). Collective efficacy is the shared belief which influence decision what members want to achieve through combined action, how much effort they put into their group and their persistence in staying while efforts fail the target (Bandura, 1982, 2000). Particularly, TFL behavior has a positive relationship with followers' collective efficacy, unit cohesiveness and cooperative behaviors (Wang & Howell, 2012). A team leaders who communicate a group level vision and who display emotional aperture will develop a positive overall evaluative judgment on team members feeling (Rafferty, Jimmieson, & Armenakis, 2013).

According to social exchange theory, leaders' team consideration creates a moral obligation in exchange from the followers (Blau, 1961). Transformational leadership is a critical factor to raise efficacy since such leader is concerned with persistent employee's personal development, collaboration and

team cohesiveness to feel capable of accomplishing assignments (Bandura, 1977, 1982; Zhu & Bao, 2017). Team members with necessary skills and assurance from strong role model for example transformational leaders boost their collective efficacy (Bandura, 1982; Ng, 2017). Transformational leaders through inspirational motivation convey followers that they have the capabilities to achieve the target so that the followers' feel confident (Bandura, 1982; Ng, 2017; Zhu & Bao, 2017). Taken together, transformational leadership behaviors boosts collective efficacy by articulating confidence in their capability to achieve extended goals (Bandura, 1982; Bass, 1985; Gang et al., 2011). Thus, we propose:

H1. Transformational leadership positively influences collective efficacy.

Perceived Organizational Support

Perceived organizational support (POS) refers when employees aware of the support from their organization (Bouckenooghe, Devos, & Broeck, 2009; Self, Armenakis, & Schraeder, 2007). POS has an important role in facilitating the relationship between transformational leadership and outcome variables (Yousef, 2000). Liao and Chuang (2007) in their study argued that transformational leaders create a positive service climate to improve employee service performance. In contrast, unlike the middle-level leaders and supervisors who can affect employees directly, only senior leaders have the power to influence perceived organization support. POS created by senior leaders influence the hierarchical distant employees and overall organizational setting to provide conducive condition (Shadur, Kienzle, & Rodwell, 1999; Stinglhamber & Vandenberghe, 2003). Thus, we can argue that the positive impact of TFL behavior on team outcomes will be strengthen by POS. Hence, we hypothesize:

H2. Perceived organizational support moderates the relationship between transformational leadership and collective efficacy, such that the relationship will be stronger under a high perceived organizational support than low.

Method

The target company for our data collection is Ethiopian Electric Utility employees. We collected 305 responses from employees. 68% of employees are male, 54% between 26 and 35, 22% between 36 and 45 years old. Most employees have first degree 58% and diploma 34%. Team members ranged 2 to 18 members, with an average team size 5.55 and (SD = 3.05) in 55 teams.

Measures

Every item was rated on a 5 point scale ranging from 1 (strongly disagree) to 5 (strongly agree). Transformational leadership was measured with 20 items adopted from (Avolio, Bass, & Jung, 1999). Five items for collective efficacy were used from (Shea, Jacobs, Esserman, Bruce, & Weiner, 2014). Perceived organizational support was measured with 8 items adopted from (Eisenberger, Huntington, Hutchison, & Sowa, 1986).

Measurement Model

We collected data from employees. Hence, we need to confirm the distinctiveness or discriminant validity among these measures. Using CFA, we tested the hypothesized three-factor model, two factor and single factor model. The CFA results shown in Table 1 revealed the hypothesized three-factor model better fit the data for the study suggesting the discriminant validity of the measures.

Table 1. Measurement Model Comparisons

Model	χ^2	df	χ^2/df	GFI	CFI	RMSEA
1. Model-1: Three Factor (Hypothesized	2151.75	555	3.88	.67	.86	.088
2. Model-2: Two Factor alternative model	3307.09	557	5.94	.53	.77	.115
3. Model-3: Single Factor alternative model	4960.65	558	8.89	.42	.63	.145

Note: df = degrees of freedom; GFI=Goodness fit index; CFI = comparative fit index; RMSEA = root mean square error of approximation.

Data Aggregation

The study focused on team level analysis. Since we collected data from individual members. We need to aggregate these individual variables to form team level variables. The procedures commonly used to justify aggregation is the extent to which individual-level data are homogeneous within the group (Klein & Kozlowski, 2000). To examine the suitability of the data aggregation, we calculated inter-rater agreement (r_{wg}) and inter-member reliability (Chan, 1998). The results for TFL behavior (median r_{wg}=.91; mean rwg=.77; ICC1 =.12; ICC2=.43), POS (median r_{wg}=.94; mean r_{wg}=.90; ICC1=.10; ICC2=.37) and collective efficacy (median r_{wg}=.88; mean r_{wg}=.78; ICC1=.14; ICC2=.47) suggesting aggregation is possible to form team level variables (Chan, 1998).

Table 2. Means, correlations and alpha coefficients

N=55 teams	Mean	1	2	3
1. Transformational Leadership	3.50	(.97)		
2. Collective Efficacy	3.67	.65**	(.92)	
3. Perceived Organizational Support	3.43	.60**	.69**	(.89)

Alpha coefficients are presented in parentheses along the diagonal. **p < .01. (two-tailed)

Regression Analysis

As shown in Table 3, Model 1 TFL has a positive significant effect on collective efficacy (b = .55, p < .001) supporting Hypothesis 1. To test Hypothesis 2, we loaded an interaction term comprising transformational leadership and perceived organizational support (TFL × POS) as predictor of collective efficacy. The result shown in Table 3, Model 2 (b =.12, p < .001) revealed that the effect of TFL behavior on collective efficacy would be stronger as POS is higher supporting hypothesis 2.

Table 3. Regression results

	Collective Efficacy =Model-1	Collective Efficacy = Model-2
Transformational Leader-Collective Efficacy	.55***	
Moderator Effect		
TFL X POS		.12***
R^2	.42	.52
F	49.10	73.02

Unstandardized coefficients reported. ***p < .001.

Discussion and Conclusion

The study contributes to the scarce team level research. Particularly, the aim of this study is to examine the influence of TFL behavior on collective efficacy. Besides, the study observed the moderating role of POS in the relationship between TFL behavior and collective efficacy. More importantly, the findings revealed that POS moderates the relationship between TFL behavior and collective efficacy positively.

In addition, the study will have some practical contributions. First, leaders through TFL behavior can improve collective efficacy of employees. Thus, leaders need to experience higher TFL behavior in order to boost collective efficacy of followers. Second, senior leaders should assist lower leaders and employees through establishing organizational supporting mechanisms such as policies and procedures. Thus, both transformational leaders and supportive organizational system may have higher positive mutual impact on collective efficacy than in isolation. The cross-sectional nature of the data can be taken as one limitation for this study. Hence, studies can extend using longitudinal data to get clear insight.

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International Journal of Organizational Innovation

THE LIFEGUARD COMPANY: ASSESSMENT OF THE GENERAL HEALTH OF THE ORGANIZATION

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Abstract

This paper is an external health audit of The Lifeguard Company based in the Midwest (United States). The organization has been experiencing reduced revenues and high employee turnover. The analysis assesses the general health of The Lifeguard Company based on the management theories largely developed by W. Edwards Deming, as well as Jerry B. Harvey, Elliott Jaques, Sergey Ivanov, and other theorists. Harvey's Abilene Paradox and W. Edwards Deming's Constancy of Purpose are identified, explained, and applied to the organization to determine if the company is plagued by various organizational issues.

Observations of the company are made over an extended period of time to determine the results (one of the authors has worked for the organization for a long period of time). The authors hope that this paper accurately identifies some of the causes of the issues plaguing The Lifeguard Company, and provides general practical solutions to improve the overall well-being of this organization, also applicable to similar organizations facing comparable dilemmas.

Key Words: Deming, organizational health, deadly diseases, Abilene Paradox, leadership

Introduction

Jerry B. Harvey (1988, 1999) and W. Edwards Deming (1992, 1993, 1994) have identified circumstances that threaten the productivity and livelihood of organizations. Harvey discusses the concepts of the Abilene Paradox and his very own definition of cheating. Deming describes deadly diseases that affect companies, especially:

1) Constancy of Purpose
2) Emphasis on Short-term Profits
3) Performance Evaluations
4) Mobility of Management.

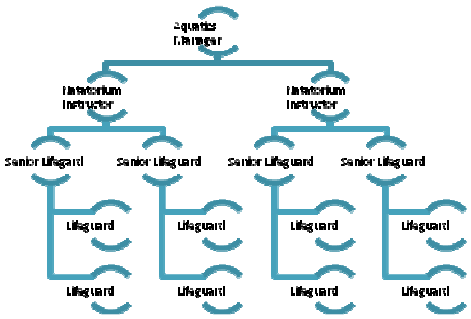
George Orwell (1961) also mentions the term "double-talk" that can occur in organizations. These concepts are applied to The Lifeguard Company's Aquatics Unit to evaluate the general health of the unit and the organization.

The Lifeguard Company or TLC, is an organization that specializes in lifeguarding services.

Structure of the Organization

The Aquatics Unit has quite a sizable staff. More than a dozen indoor pools are managed year-round while several outdoors pools and beaches are staffed throughout the summer seasons.

There are over 250 year-round employees at indoor locations, while an additional 700 seasonal staff are hired to manage the additional facilities that get opened. The main function of the Aquatics Unit is the lifeguarding service. The following diagram depicts the hierarchical structure of the Aquatics Unit: Aquatics Manager, Natatorium Instructors, Senior Lifeguards, and Lifeguards, and Senior Lifeguards:



The Aquatics Manager oversees all operations and locations. Natatorium Instructors manage an individual location. Each pool and beach gets one Natatorium Instructor. Senior Lifeguards are directly in charge of the daily assignments lifeguards have. Depending on size, each location will get one or two Senior Lifeguards.

Lifeguards are the foot soldiers that perform main duties. They report to the Senior Lifeguard(s) and Natatorium Instructor of their location. Each location gets a half-dozen to two-dozen Lifeguards (depending on the size of the pool/beach).

Organizational Issues

Double-talk

Double-talk is defined as talk with the intent to mislead, confuse, and/or manipulate the audience. Double-talking was present in the organization with top management being the culprit.

Employees are given the impression that one must achieve high performance

evaluations to progress through the "corporate ladder." Observations showed that employees who consistently received top evaluations from their Natatorium Instructor were rarely offered promotions. Others, with similar experience in terms of years working for the company but with lower evaluations did receive promotions. The take away was that the evaluations mean as much or as little to top management (Aquatics Manager) as deemed necessary.

Improved Leadership By Top Management Is Needed To Implement A Fair System.

Cheating

Jerry Harvey's definition of cheating is stated as denying help to others who request it. He admonishes the use of the traditional definition of cheating. His examples are used in school and the workplace.

One of the things that The Lifeguard Company does well with its lifeguarding service is the use of teamwork. Never is one person working by themselves as the work required is done so with a team of lifeguards.

This enables lifeguards to establish relationships with coworkers and build chemistry, and thus, makes it easy to rely on others with confidence.

Constancy of Purpose

Deming's first organizational disease is Constancy of Purpose. This refers to a lack of job creation. Job creation is achieved by gaining new customers through new products and services.

The Aquatics Unit does not offer products. What it does offer is a limited number of services including its lifeguard service. The lifeguarding service offered is second to none in the country. Strict enforcement of safety rules ensures that patrons remain safe from drowning. The other services offered are lap swims, swim teams, and learn to swim lessons for people of all ages.

However, there is no intention or long-term plan to offer more services. Therefore, the unit is afflicted with what is arguably the deadliest disease. It is recommended that the organization establish a 5-year plan as well as a 10-year plan that includes potential new services that would gain new customers.

Emphasis on Short-Term Profits

The organization is also plagued by the disease of placing emphasis on short-term profits. The greatest example is a change that will take place in the summer of 2017.

Generally, most beaches on the lakefront have a permanent structure that is used by lifeguards in the summer season. These lifeguard beach houses have a concession stand or restaurant next to them. Starting in the summer of 2017, these beach houses will no longer be used by lifeguards, but instead rented out to the concession stands/restaurants next door to increase rent revenue.

The lifeguards will now have to station themselves inside a mobile

trailer. These trailers are very limited in space and are viewed negatively by most if not all of the staff (a trip to Harvey's Abilene).

While it may be too late to salvage the beach houses for lifeguard use, there are solutions for preventing further cuts in the future. These resolutions revert back to the lack of innovation. The need for a long-term strategy is a key for long term well-being of a company.

Performance Evaluations

Deming (1992, 1993, 1994) explained that performance evaluations are ultimately more harmful than helpful to an organization. They are time consuming, costly, and they deflect blame onto employees for work conditions of out their control.

The story is no different in the Aquatics Unit as there are evaluations performed every two weeks. Staff are rated from 1-5 (does not meet expectations- exceeds expectations).
The evaluation sheets used are out of date as some of the criteria is no longer relevant yet still continues to be used to rate employees.

The evaluation needs to be removed completely. Not only will it improve employee morale but it will save the organization money. It will enable Natatorium Instructors to partake in effective leadership roles to properly manage their locations without the need for evaluations.

Mobility of Management

The final disease that plagues The Lifeguard Company is the mobility of management. The high turnover in management leads to poor leadership and contributes to the turnover rate of lifeguards as well.

There is a mobility issue because of the lack of trust there is of top management. Some of this refers to the double-talking but it also deals with a bad relationship between managers (Natatorium Instructors) and top management (Aquatic Manager).

Top management is out of touch with its subordinates and not willing to make changes to better accommodate the needs of Natatorium Instructors. Some of these needs include more equipment for some pool locations and more staff for locations where staff levels are right at the minimum.

Lack of leadership at the top has a trickle-down effect that causes turnover. Therefore, there needs to be better communication between top management and subordinates to improve relations and overall employee satisfaction. Hearing out the needs of managers so that they can effectively do their job would be key in curing this disease.

Conclusion

The Lifeguard Company, and especially its Aquatics Unit, is sick. It has several of Deming's deadly diseases, double-talk, and others.

The long-term success of the organization is at risk and things are likely to get worse before they can get better.

There is still hope, however, as top management can begin to take corrective actions through leadership. True change is going to require strong leadership at the top who prioritizes strategies of innovation to foster long-term health. An emphasis on employee productivity and satisfaction would also pay dividends for years to come.

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A STUDY ON THE MODEL OF CONTINUOUS USE OF INFORMATION SYSTEM TECHNOLOGY MANAGEMENT IN ATHLETIC TRAINING TEACHING AND ATHLETES – TAKING CABLE WAKEBOARDING FOR EXAMPLE

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Abstract

This study aims to explore how modern sport management applies and develops information technology system. It treated cable wakeboard waterskiing as the target to further propose modernized sports instruction training and operational management model. According to related theories and findings on the continuous use model of information system, validation, perception, satisfaction, cognitive key and virtual ideology, this study explored and proposed research framework and hypotheses. Using Cronbach's, it tested the reliability and internal consistency of the scale. Confirmatory factor analysis was conducted to measure the variables of model, and SEM was employed to validate hypothesis relationship between variables and latent variables. The subjects of this study were coaches, athletes and members of the International Waterski and Wakeboard Federation (IWWF), five-star competitions recognized by the IWWF, cable waterskiing competitions in Asia and Oceania in 2017 and waterskiing clubs legally registered in Taiwan in 2018. The countries of participants include Australia, Japan, Singapore, Korea, Indonesia, Kuwait, Iran, Hong Kong, Thailand, the Philippines and Taiwan. This study distributed 100 questionnaires, and retrieved 98 valid samples, with a valid return rate of 98%. The results showed that there are direct correlations and mutual effects between validation and perception, validation and satisfaction, and perception and satisfaction of the users of the waterskiing information management platform. Based on the findings, this study proposed specific suggestions regarding the waterskiing information management platform and waterskiing education technology management.

Keywords: sports technology, sport management, sport communication, innovative instruction, behavioral intention

Research Background and Motives

The Ministry of Economic Affairs, R.O.C. noted in the latest Industry Vision and Policy Development Report in 2018 that, in order to face social issues, such as sub-replacement fertility, aging, urbanization, and technologicalization, advanced countries around the world have started to develop and promote relevant prospective policies and measures and to engage in specific behaviors, such as assisting in industrial innovation, in an attempt to respond to the life technology application model under the rapid transformation of information technology. Artificial intelligence, information bandwidth, cloud data, Internet of things (IoT), smart management, etc. have all extended from information technologicalization and become the important development trends of Taiwan's current industrial, governmental and academic status (Taiwan Industrial Policy Prospective Research Project, 2018). Without a doubt, under the economic structure of recreation industry and the application and development of information technology in Taiwan, virtual teaching and training have been simultaneously put into practice in academia and industries in line with international trends. For example, the applications of virtual teaching of Facebook Oculus VR to the capturing of character images, virtual experience learning, 3D model development, integration of application scenarios, etc. have gradually become necessary models of new information technologies in the current teaching, training, entertainment, and recording aspects, which have also started to change the self-learning patterns and sports learning approaches of the global population (Department of Industrial Technology, Ministry of Economic Affairs, 2017). Jacky (2016) took a new product of sports technology, Zwift online virtual sports training platform, which attaches importance to virtual reality, interactive games, and image recording, and suggested that such a product aims to improve the convenience, management, and diversity of sports learners. Wu & Kao (2008) suggested that the feedback messages provided by teaching visualization can utilize image reconstruction to perform self-inspection and engage in mutual learning so as to further improve self-reflection and specific performance of behaviors. From the perspective of multiple learning, the inspection of information technology and the application of images can also be used to enhance learners' different learning motivations (Santagata, Zannoni, & Stigler, 2007). Moreover, information record management can be employed to enable learners to fully observe more different physical performances, which will be significantly beneficial to learners' movement appreciation and analysis skills (Sööt & Leijen, 2012).

The intervention of information technology into athletic training and teaching in recent years has become a comprehensively used approach and tool by trainers and teachers. After the systematic management of

relevant information and data, such an approach/tool even has become an important reference for athletes to manage self-training and for research to focus on academic units. For example, Sheffield Hallam University in the U.K. has started to implement a teaching project that has been improved through sports technology. In this project, information technology is used to collect relevant sports digital information and data and to further develop specific models of athletic training courses so as to help athletes achieve great performances and obtain technological training management from events (Tseng & Tsai, 2010; Cho, J, 2016). Therefore, this study intends to retain the full videos of athletes' complicated movements during training and offer them an information platform for appreciation and discussion to assist coaches and players in using relevant information and data and further enhance athletes' multiple learning motivations and skill learning achievements. Sööt & Viskus (2014) suggested that in addition to skill training, movement education should attach more importance to individual development and learning. How to use information technology and the Internet to implement teaching, social interactions, and management has become an important issue attracting the attention of researchers in recent years (Dania et al., 2011). Based on the above, the 2018 policy implementation guidelines in Taiwan point out the use of digital technology to promote the sports and leisure industry and to build a foundation for the training of elite athletes, as well as the application of sports scientific training and modern technology management. They are some of the important indices for the industrial development, training innovation, and flipping teaching of current sports in Taiwan (Executive Yuan, 2018).

Taiwan completed the construction of The Cable Park in 2013, making it the first park to meet the international standards in Taiwan, and started to regularly hold domestic and foreign large-scale waterskiing events. With the promotion and development of the International Waterski and Wakeboard Federation (IWWF), cable wakeboarding will become one of the events at the Summer Olympics in 2020. Therefore, now is an important stage for Taiwan to promote the development and management of cable wakeboarding, which is a sporting event that is widely known globally.

Cable wakeboarding focuses on physical coordination, movement skills, and brilliance in performance. As a result, it is necessary to pay more attention to players' actual situation, movement performance, physical fluidity, body language, and interactive learning during training to more easily improve their training efficiency, learning motivations, and skill performances (Lee, 2015a; Lee, 2015b; Huang and Lee, 2015). Lee and Wang (2016) indicated in Sport Sciences Supporting Strategies of Taiwan for the 2016 Rio Olympic Games that the intervention and assistance of sports science have become an important approach and tool adopted by current sports organizations in advanced countries in order to effectively manage organizations, train players, promote sports, and meet international standards. More-

over, the concept of "quantified self" has also gradually won recognition by the public, which has also contributed to the vigorous development of markets and products for many wearable devices. In addition, the concepts of sports, science, and health have been integrated with relevant products and services. Consequently, the management of sports information technology has become an important research field and direction (Chien Chang, Lee, and Shiang, 2016; Yao, 2017).

Information System Continuance Model (ISCM) is a behavioral model investigating users' intention and correlation of cognitive belief, emotion, and continuous use and is one of the first quantified theoretical models employed for measuring the continuous use of information systems (Bhattacherjee, 2001a). Such a model can explain the level of perception, emotional attachment, and overall current status of development of specific self-behaviors of users, who continue utilizing an information system, as well as explore individuals' perception, usability, and continuous use of specific things or objects. The application of such a model to the exploration of things or objects and self-development can reduce the costs of the overall environment and create positive and substantial benefits to selves, organizations, enterprises, society, etc. (Bhattacherjee, 2001b; Lee, 2010; Hsu, Chen, and Lee, 2015). Based on the above, with the rapid development of information technology, the application and management of information technology systems have become important application directions for various fields. The framework of ISCM has thus been utilized to explain and predict users' satisfaction with and intention to continue using an information system, in order to achieve accurate evaluation and understand critical factors affecting them (Huang et al., 2017). Bhattacherjee (2001ab) further proposed Confirmation, Satisfaction, and Perceived Usefulness as the constructs/indices for explaining or predicting the relevance of users' subsequent behaviors (Davis, 1989).

Relevant past studies indicated that the confirmation and perception of individuals using an information system affect their intention to continue using it and the correlation with satisfaction. Confirmation affects users' self-perception and self-satisfaction and may also intervene with their continuous use of relevant information systems in the future (Davis, 1989; Lin & Hsieh, 2007; Lee, 2010; Lu, Liu & Wei, 2017). Therefore, Oliver (1980) proposed the Expectation- Confirmation Theory (ECT), or the Expectation Gap Theory, to explain whether Expectation, Perceived Performance, Confirmation, Satisfaction, and Repurchase Intention have a direct or indirect effect on users' continuous use, and such a theory started to be comprehensively applied and verified in relevant studies and theories. As a result, users' confirmation of their acceptance of a system indeed affects their satisfaction with and perceived usefulness of the system. The correlation between them also intervenes with users' specific perception and behaviors of subsequent use (Lu, Liu & Wei, 2017; Liu and Wu, 2017). The results of the study by Susanto, Chang and Ha (2016) where

enterprises in South Korea were taken as a sample showed that the perception, convenience, and need of users during system operation indeed lead to different self-awareness of use, which further directly affects the intention to reuse this system by themselves and the population in order to complete relevant operations and achieve the objectives set up by themselves. Therefore, this study proposes five relevant research hypotheses.

H1: The confirmation of users of a water skiing sports information management platform has a significant effect on their perceived usefulness.

H2: The confirmation of users of a water skiing sports information management platform has a significant effect on their satisfaction.

H3: The perceived usefulness of users of a water skiing sports information management platform has a significant effect on their satisfaction.

H4: The perceived usefulness of users of a water skiing sports information management platform has a significant effect on their continuous use.

H5: The satisfaction of users of a water skiing sports information management platform has a significant effect on their continuous use.

Rheingold (1993) suggested that as long as there is a certain number of people using the Internet, the constructs of specific practicality, such as continuous use, mutual exchange, and operational management, can be developed, and that a community and culture can be established by consensus. Therefore, virtual community consciousness forms an important core value in the community, and exchange, communication, and sharing enable users to accumulate common experiences and knowledge background (Blanchard, 2004). In addition to being able to retrieve information and data from a community, users who actively join a virtual community are also able to be satisfied with the improvement of a sense of belonging and the strengthening of interpersonal relationships (Wellman, 2005). Castro (2007) indicated that an Internet community can create a remote sense of presence and imagination for users and win them a sense of trust through the experiences of system information services, which can directly affect their intent to use and behavior of continuous use. The results of Yen et al. (2011) showed that an information technology system with a high sense of trust, high usability, high community features, and high consensus affects users' consciousness and behavior. Moreover, during the usage, users will change themselves, continue using it, or recommend it to others (Lu and Lee, 2014; Liao, 2016). Hsu and Lu (2004) suggested that the Internet or a specific information system indeed will affect user behaviors and will be affected by groups to further change selves or affect groups. Based on the above, the cognitive key is to transfer a positive perception and good experiences to users. Moreover, the use of an information system can be popu-

larized and integrated with life through sharing and an increase in users, which can improve their own usage effectiveness and objectives and further strengthen their behavior consciousness and sense of identity (Chiu and Chuang, 2013; Chang and Shao, 2017). We now present two further hypotheses.

H6: The virtual consciousness of users of a water skiing sports information management platform has a significant effect on their continuous use.

H7: The cognitive key of users of a water skiing sports information management platform has a significant effect on their continuous use.

Based on the above, the difference in confirmation and perceived usefulness of users using an information system indeed may affect their satisfaction with their use. In addition, users' cognitive key and virtual consciousness toward an information system may also affect their continuous use of the system. Therefore, the confirmation of an overall behavioral intention model and correlation of users using an information system make up an important foundation for future organizational management (Grönroos, 2006; Morrisson and Huppertz, 2010) as well as an important reference for teaching or training of first-line educators (DeWitt et al., 2013; Sööt & Viskus, 2014).

It is not enough for modern sports teaching to provide students with videos for observation and practice only (Fill & Ottewill, 2006). It is extremely difficult for students or players to reflect on their learning if there is not any information e-platform that guides and helps them to engage in learning (Sööt & Leijen, 2012). Therefore, in addition to providing videos for browsing and clarifying the feedback content of images, an information system platform further uses technology management to provide critical messages to help players make professional judgements and predict whether their movement performance is accurate so as to further improve their self-image's ability to control limbs, reduce errors (Schmidt & Wrisberg, 2008), and more effectively grasp learning progress and improve learning performance (Kay, 2012). As a result, in order to surpass innovative teaching and organizational technology management and achieve synchronization of player information technology in future cable wakeboarding, it is necessary to better understand athletes' continuous use behavior for an information system. Only when relevant theoretical constructs are used to analyze the correlation can the modern management platform for athletes be proposed and established to achieve the specific objectives of developing players' physical and mental balance, skills, social interaction, and learning (Lee, 2015ab; Lin et al., 2016; Lai, 2016; Chien, Liang, and Chen, 2017).

Research Method

Research Structure

Based on the theories and research results concerning ISCM, confirmation, perceived usefulness, satisfaction, cognitive key, and virtual consciousness, this study pro-

pose the following specific research hypotheses and framework after the investigation.

H1: The confirmation of users of a water skiing sports information management platform has a significant effect on their perceived usefulness.

H2: The confirmation of users of a water skiing sports information management platform has a significant effect on their satisfaction.

H3: The perceived usefulness of users of a water skiing sports information management platform has a significant effect on their satisfaction.

H4: The perceived usefulness of users of a water skiing sports information management platform has a significant effect on their continuous use.

H5: The satisfaction of users of a water skiing sports information management platform has a significant effect on their continuous use.

H6: The virtual consciousness of users of a water skiing sports information management platform has a significant effect on their continuous use.

H7: The cognitive key of users of a water skiing sports information management platform has a significant effect on their continuous use.

Research Subjects

This study enrolled coaches, players, and members involved in 5-star event, 2017 Asia & Oceania Waterski Championships, certified by the IWWF and a waterskiing club in Taiwan in 2018 as the main research subjects. Eleven countries participated in the event, including Australia, Japan, Singapore, South Korea, Indonesia, Kuwait, Iran, Hong Kong, Thailand, Philippines, and Taiwan. This study conducted a questionnaire survey and then performed the statistical analysis. A total of 98 valid questionnaires were returned, including 30 questionnaires completed by female subjects (32%) and 68 questionnaires completed by male subjects (68%). All 98 subjects (100%) have used the Internet, and 89 subjects (90.8%) have watched online waterskiing events or teaching videos and information.

Measurement Tools

This study used a structured questionnaire to obtain the data needed for verifying the research hypotheses. To meet the needs of the research purposes, the questionnaire content included 7 parts: personal basic information, user confirmation, user perceived usefulness, user satisfaction, user continuous use, user virtual consciousness, and user cognitive key. This study applied a

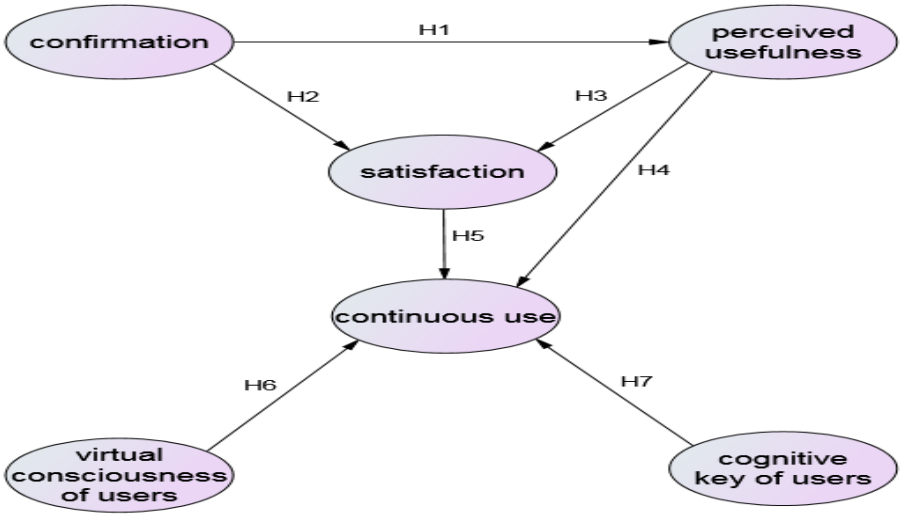

Figure 1. Model Framework of Continuous Use of Information System Technology Management in Athletic Training Teaching and Athletes

7-point Likert scale to the measurement of all the items (Bollen, 1989). The answers included: Strongly agree (7), Agree (6), Slightly Agree (5), Fair (4), Slightly Disagree (3), Disagree (=2), and Strongly Disagree (=1). Confirmation included a total of 5 items (α reliability is .889); perceived usefulness included a total of 5 items (α reliability is .872); satisfaction included a total of 5 items (α reliability is .848); continuous use intention included a total of 5 items (α reliability is .819); virtual community consciousness included a total of 5 items (α reliability is .901); and cognitive key majority included a total of 5 items (α reliability is .852).

Data Analysis

This study used statistical software, SPSS for 20.0Windows and Mplus, to test and analyze the research samples and used Cronbach's coefficient to test the internal consistency reliability of the scale. Afterwards, this study used Confirmatory Factor Analysis (CFA) to measure the variables of the model (Hair, Black, Babin, Anderson and Tatham, 2006). According to Kline (2005), a model has to be tested and measured before the correction of the two-stage model, and then the SEM can be further used to measure the hypothetical relationship between variables and potential variables (Memon & Rahman, 2013).

Results and Discussion

According to the suggestion from Anderson & Gerbing (1988), the analysis of a complete Structural Equation Model (SEM) is mainly divided into two stages. Stage 1 includes the Measurement Model. Stage 2 is the evaluation of the Structural Model. Based on the above, this study used Confirmatory Factor Analysis (CFA), which is equivalent to the evaluation of a

measurement model and is part 1 of the analysis of the Structural Equation Model (SEM), and then corrected the two-stage model of part 2 (Kline, 2005).

Measurement Model

1) Convergent Validity

For the measurement model, this study adopted maximum likelihood estimation. The estimated parameters included factor loading, reliability, convergent validity, and discriminant validity. According to the standards of convergent validity proposed by Fornell and Larcker (1981), this study performed the testing as follows: (1) the Standardized Factor Loading of each index variable is higher than .50; (2) Composite Reliability is higher than .60; and (3) Average Variance Extracted is higher than .50. Chin (1998) suggested that, ideally, the reliability and standardized factor loading of items should be higher than .7, and those higher than .6 are acceptable. Consequently, Hooper, Coughlan, & Mullen (2008) recommended that items whose standardized factor loading is lower than .45 should be deleted, because they involve many errors. Moreover, the squared multiple correlation is the squared standardized factor loading.

Based on the above, this study tested relevant values according to the standards mentioned above and summarized non-standardized factor loading, standard error, significance test, standardized factor loading, squared multiple correlation, composite reliability, and average variance extracted in Table 1. The results showed that the standardized factor loading was .607-.859, meeting the standard, implying that the reliability of each item was acceptable. The composite reliability of the research constructs was .845-.904 (all higher than .7), meeting the standard recommended by Nunnally and Bernstein (1994), and suggested that the internal consistency of each construct was good. The AVE was .525-.655 (all higher than .5), meeting the standard proposed by Hair, Anderson, Tatham, and Black.

Table 1. Analysis Results of the Measurement Model of Continuous Use of Information System Technology Management in Athletic Training Teaching and Athletes

Construct	Item	Significance of estimated parameters				Item Reliability		Construct Reliability	Convergence validity
		Unstd	S.E.	Unstd./S.E.	P-Value	Std.	SMC	CR	AVE
Confirmation	CO1	1.000				0.719	0.517	0.891	0.620
	CO2	0.958	0.061	15.636	0.000	0.787	0.619		
	CO3	1.130	0.124	9.134	0.000	0.849	0.720		
	CO4	1.009	0.114	8.867	0.000	0.837	0.701		
	CO5	0.826	0.136	6.081	0.000	0.729	0.531		
Perceived usefulness	PU1	1.000				0.754	0.569	0.878	0.590
	PU2	1.250	0.147	8.534	0.000	0.760	0.578		

	PU3	1.020	0.136	7.524	0.000	0.800	0.641	
	PU4	1.064	0.230	4.624	0.000	0.727	0.529	
	PU5	0.968	0.129	7.520	0.000	0.795	0.633	
Satisfaction	SA1	1.000				0.721	0.520	0.850	0.533
	SA2	1.033	0.113	9.110	0.000	0.719	0.518	
	SA3	1.337	0.160	8.356	0.000	0.813	0.660	
	SA4	1.056	0.184	5.728	0.000	0.663	0.440	
	SA5	0.974	0.122	8.002	0.000	0.730	0.532	
Continuous use	CI1	1.000				0.748	0.560	0.845	0.525
	CI2	0.869	0.118	7.384	0.000	0.679	0.462	
	CI3	1.000				0.697	0.486	
	CI4	1.210	0.243	4.984	0.000	0.607	0.368	
	CI5	1.026	0.126	8.141	0.000	0.859	0.738	
Virtual consciousness	VC1	1.000				0.792	0.627	0.904	0.655
	VC2	0.935	0.094	9.975	0.000	0.792	0.627	
	VC3	0.904	0.113	8.006	0.000	0.791	0.626	
	VC4	0.935	0.099	9.439	0.000	0.842	0.709	
	VC5	0.802	0.084	9.590	0.000	0.827	0.684	
Cognitive key	CM1	1.000				0.771	0.595	0.863	0.560
	CM2	0.530	0.109	4.862	0.000	0.647	0.418	
	CM3	0.499	0.120	4.145	0.000	0.674	0.455	
	CM4	0.911	0.087	10.450	0.000	0.807	0.651	
	CM5	0.939	0.085	11.071	0.000	0.825	0.680	

(1998), Fornell and Larcker (1981) 2) Discriminant Validity and denoting that the convergent reliability of each construct was good.

This study adopted the rigorous AVE method to test the discriminant validity of the model. Fornell and Lacker (1981) suggested that during the application of discriminant validity, it is necessary to concurrently take into account the relationship between convergent validity and constructs. Therefore, they said that the square root of AVE of each construct should be greater than the correlation coefficient among constructs to meet the standard and to show that there is discriminant validity in the research model. Based on the above, after the verification, this study discovered that the square root of AVE of each construct was greater than the diagonal correlation coefficient, implying that the discriminant validity of each construct was good, as shown in Table 2.

Table 2. Analysis of Discriminant Validity of the Measurement Model of Continuous Use of Information System Technology Management in Athletic Training Teaching and Athletes

	AVE	CO	PU	SA	CI	CM	VC
CO	.620	**.787**					
PU	.590	.776	**.768**				
SA	.533	.806	.832	**.730**			
CI	.525	.741	.705	.746	**.725**		
CM	.655	.649	.617	.605	.663	**.809**	
VC	.560	.602	.576	.617	.674	.775	**.748**

CO=confirmation; PU=perceived usefulness; SA=satisfaction; CI=continuous use; VC=virtual consciousness; CM =cognitive key majority.

3. Structural Model Analysis

After testing the measurement model of "continuous use of information system technology management in athletic training teaching and athletes," this study performed structural model analysis and maximum likelihood estimation, including model fit, significance test of research hypotheses, and explained variance (R^2). However, SEM is an analysis method for large sample sizes. Therefore, the P value tends to be less than .05, which can cause a false rejection of a hypothesis and reach a conclusion of a poor model.

Therefore, Kline (2005) and Schumacker and Lomax (2010) suggested that the model fit should not be determined by the p value, and different goodness-of-fit indices should be proposed to determine whether the model fit is good. As a result, this study used 9 goodness-of-fit indices that are the most comprehensively used to analyze the research model according to the study by Jackson, Gillaspy, and Purc-Stephenson (2009) where relevant theories of 194 SSCI international academic papers were investigated, as shown in Table 3. After rigorous analysis of the model, the results showed that except for χ^2 (the smaller the value, the better the model fit), all the goodness-of-fit indices met the standards recommended (Schumacker and Lomax, 2010). Because χ^2 is very sensitive to large sample sizes, chi-square value/degree of freedom is required for the evaluation. Moreover, the ideal value of a good model fit should be less than 3. Therefore, Hu and Bentler (1999) indicated that each index should be independently evaluated, and more rigorous goodness-of-fit indices should be used to concurrently control type I and type II errors, such as Standardized RMR <.08 and CFI>.90 or RMSEA <.08.

After the numerical verification steps and analysis and verification of the model mentioned above, the path coefficient results of the model, as in Table 4, showed in the measurement model of continuous use of information system technology management in athletic training teaching and athletes that the confirmation of users of a water skiing sports information management platform (b=.751, p<.001) has a significant effect on their perceived usefulness, and confirmation (b=.298, p=.039) and perceived usefulness (b=.592, p<.001)

Table 3. Model Fit Analysis of the Measurement Model of Continuous Use of Information System Technology Management in Athletic Training Teaching and Athletes

Model fit	Criteria	Model fit of research model
MLχ^2	The small the better	978.178
DF	The large the better	395.000
Normed Chi-square (χ^2/DF)	1<χ^2/DF<3	2.476
RMSEA	<0.08	0.085
SRMR	<0.08	0.068
TLI (NNFI)	>0.9	0.854
CFI	>0.9	0.868
GFI	>0.9	0.798
AGFI	>0.9	0.778

have a significant effect on satisfaction. Perceived usefulness (b=-.727, p=.512), satisfaction (b=1.566, p=0.213), virtual consciousness (b=0.204, p=0.432), and cognitive key (b=-.007, p=.981) have a significant effect on cognitive key. Based on the above, the path coefficient diagram of the research model is summarized in Figure 2. The results of relevant values also showed that confirmation can explain 80.3% of perceived usefulness; confirmation and perceived usefulness can explain 96.1% of satisfaction; and perceived usefulness, satisfaction, virtual consciousness, and cognitive key can explain 87% of continuous use.

Therefore:
H1 is supported (value=.751);
H2 is supported (value=.298);
H3 is supported (value=.592);
H4 is not supported (value=-.727);
H5 is not supported (value=1.566);
H6 is not supported (value=.204);
H7 is not supported (value=-.007).

Discussion

This study used the statistical methods mentioned above to test and verify the relevant hypotheses and judged the effects among potential variables based on critical ratios. This study used path coefficient values of the model to confirm the significance level and whether the research hypotheses were supported.

Therefore, the verification results of the research hypotheses are summarized as follows.

1. Analysis on the relationship between the confirmation of users of a water skiing sports information management platform and perceived usefulness.

H1: "The confirmation of users of water skiing sports information management platform has a significant effect on perceived usefulness" is supported.

Table 4. Regression Coefficient Analysis of the Measurement Model of Continuous Use of Information System Technology Management in Athletic Training Teaching and Athletes

DV	IV	Unstd	S.E.	Unstd./S.E.	P-Value	Std.	R^2
PU	CO	0.751	0.096	7.812	0.000	0.896	0.803
SA	CO	0.298	0.145	2.060	0.039	0.377	0.961
	PU	0.592	0.162	3.662	0.000	0.628	
CI	PU	-0.727	1.108	-0.656	0.512	-0.659	0.870
	SA	1.566	1.258	1.245	0.213	1.337	
	VC	0.204	0.260	0.786	0.432	0.303	
	CM	-0.007	0.281	-0.023	0.981	-0.013	

CO=confirmation; PU=perceived usefulness; SA=satisfaction; CI=continuous use; VC=virtual consciousness; CM=cognitive key majority.

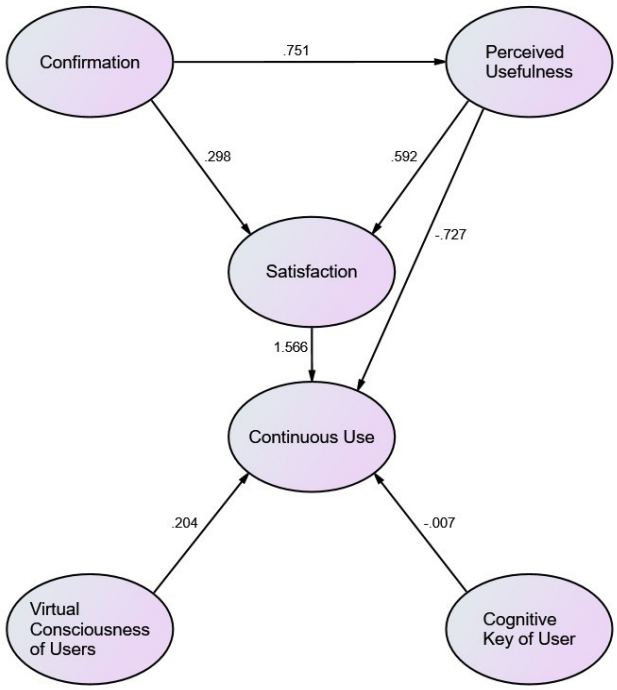

Figure 2. Model of Continuous Use of Information System Technology Management in Athletic Training Teaching and Athletes

This result is similar to that of the studies by Lin and Wang (2012) and Guo, Barnes, and Jia (2017). Thus, the expectation and obtainment of information system technology management by users of a water skiing sports information management platform are very important, because the self-meaning and scenario framework will affect selves' perceived usefulness of system application and management and further cause individuals to be involved in obstacles or problems.

2. Analysis on the relationship between the confirmation of users of a water skiing sports information management platform and satisfaction

H2: "The confirmation of users of water skiing sports information management platform has a significant effect on satisfaction" is supported.

This result is similar to that of the studies by Lin and Wang (2012), Sun, Fang and Zou (2016). Thus, the practicality and value of information system technology management to users of a water skiing sports information management platform are very important, because higher knowledge power and power structure of individuals for the system will further affect their satisfaction and continuous use.

3. Analysis on the relationship between the perceived usefulness of users of a water skiing sports information management platform and satisfaction

H3: "The perceived usefulness of users of water skiing sports information management platform has a significant effect on satisfaction" is supported.

This result is similar to that of the studies by Hsia, Huang and Hwang (2015) and Cho (2016). Thus, the applicability and ease of use of information system technology perceived by users of a water skiing sports information management platform are very important, because higher operational convenience and interactivity perceived by individuals will affect their development of positive value for system use and further affect their satisfaction.

4. Analysis on the relationship between the perceived usefulness of users of a water skiing sports information management platform and continuous use.

H4: "The perceived usefulness of users of water skiing sports information management platform has a positive effect on continuous use" is not supported.

This result is different from that of the studies by Tsai, Cheng, and Chen (2011) and Guo, Barnes, and Jia (2017). The reason might be that currently the IWWF and formal and official organizations of waterskiing in various countries have not established a certification system or set up an organizational and systemic Internet platform, resulting in players' lack of information, low information reliability, or a lack of management that affects users' loyalty to

information system browsing and intention to recommend.

5. Analysis on the relationship between the satisfaction of users of a water skiing sports information management platform and continuous use.

H5: "The satisfaction of users of water skiing sports information management platform has a significant effect on continuous use" is no supported.

This result is different from that of the studies by Lee (2010) and Chen, Yu, and Li (2016). The reason might be, as extended from the viewpoint on the effect of perceived usefulness on continuous use mentioned above, because users' loyalty and intention to recommend are low, and hence their continuous use intention is further affected.

6. Analysis on the relationship between the virtual consciousness of users of a water skiing sports information management platform and continuous use

H6: "The virtual consciousness of users of water skiing sports information management platform has a significant effect on continuous use" is not supported.

This result is different from that of the studies by Bart, Shankar, Sultan, & Urban (2005) and Tsai, Cheng, and Chen (2011). The reason might be because, as extended from the viewpoint on the effect of perceived usefulness on continuous use mentioned above, the lack of an official organization and representative information system Internet browsing platform and the lack of a verification and accreditation system for online information and messages influence users' sense of trust in virtual consciousness and cause groups' continuous use of system platform. Bart, Shankar, Sultan, and Urban (2005) emphasized that the profession of a message source is the fundamental requirement for Internet trust.

Therefore, the profession and fairness of websites are very important. If the recommendation messages on blogs can provide sufficient information and services, then users can also develop trust in the blogs and relevant messages. The higher the trust is, the higher the users' behavioral intention to browse blogs is (Birgit, 2001; Castro, Armario &Ruiz, 2007).

7. Analysis on the relationship between the cognitive key of users of a water skiing sports information management platform and continuous use.

H7: "The cognitive key of users of water skiing sports information management platform has a significant effect on continuous use" is not supported.

This result is different from that of the studies by Hsu and Lu (2004) and Schmidt & Wrisberg (2008). The reason might be that, as extended from the viewpoint on the effect of virtual consciousness on continuous use mentioned above, the profession and fairness of an information system platform are the fundamental requirements affecting us-

ers' Internet trust. Tseng & Tsai (2007) and Chen, Liu, Shih, Wu & Yuan (2011) indicated that common online systems can increase learners' opportunity at multiple learning and reduce the pressure of interactive learning in peer scenes. Science and technology should be used to provide individualized instruction, communication, and feedback in order to improve and elevate teaching quality, rather than to replace the entire learning and training process (Dania et al., 2011). Consequently, at present, the trust, profession, and fairness of the Internet have become important observation indices for modern information technology or online teaching. These may also be what the platform is currently deficient in, which further affects the relationship between cognitive key and continuous use.

Conclusions and Suggestions

After an investigation of relevant theories and statistical tests and analyses using the research methods and design, this study found that there are indeed potential correlations and mutual effects between confirmation and perceived usefulness, confirmation and satisfaction, and perceived usefulness and satisfaction of users of a water skiing sports information management platform. Therefore, this study propose specific suggestions as follows.

1. Suggestions on a water skiing sports information management platform. According to the research results, in the "model of continuous use of information system technology management in athletic training teaching and athletes," "confirmation" is very important, because this variable directly affects the correlation between perceived usefulness and satisfaction. Therefore, in future management, the "knowledge power" and "power structure" of the platform should be strengthened, because the development of "knowledge power" can convert text messages and image files into accurate, important, and systemic information for transmission to enable users to engage in learning and exchanges in the professional fields to which they attach importance. In this way, users can develop attachment and further establish usage habits and reliability to increase the perception and experience value of confirmation, which is very important to "confirmation." In terms of "perceived usefulness," "power structure" should be developed, because users will develop a relevant strength of perceived usefulness after the confirmation. Users' perceived usefulness and cognitive belief are extended from perceived usefulness, which further affects their behavioral intention. Therefore, the identity or class of platform users, such as coaches, players, and members, can be further used to divide the platform into basic platform, advanced platform, high-level platform, or theme platform to assist users in self- inspection and help in the interactions and exchanges between users of the same class. In this way, the learning effectiveness can be improved and the level of profession can be elevated. Creating a specific platform for professional use can increase users' perceived usefulness and satisfaction.

2. Suggestion on technology management of waterskiing sports educa-

tion. The Internet, information systems, big data, technology management, etc. have all become important sports management trends in various advanced countries. According to the research results, users of a waterskiing information system all have used the Internet for learning and utilized relevant messages to enhance themselves and develop learning skills. Therefore, the development of modern waterskiing teaching and training, school waterskiing sports, national waterskiing sports, competitive waterskiing sports, and commercial waterskiing sports in the future will be fully dependent upon waterskiing sports educators' new model of "technology-based teaching materials and teaching methods," as well as technology management and application of a waterskiing information system.

Therefore, based on the research results of the correlation among confirmation, perceived usefulness, and satisfaction, this study suggests that "vertical development" is required for a waterskiing information system: school waterskiing courses should be digitalized and graded. Moreover, "knowledge power" should be developed to enhance the brand and education of information and to improve the confirmation of student and public users.

For "virtual union:" industries should be combined with commercial models, and teaching materials and products should be classified and integrated to help combine online virtual teaching with physical stores so as to popularize the market of waterskiing sports in the aspects of life and services. For "cross-border development:" the system should be combined with the diversity of competitive waterskiing sports, and national players and professional players should be hired as faculties within the information system platform. Moreover, activities or teaching should be regularly provided at waterskiing clubs in order to understand waterskiing sports participants' actual needs and motivations, solve their problems, develop affections, and expand the potential market population, which would then increase the reputation and usage of the information system platform. In the future, work opportunities can be further developed on the market for sports coaches to create and promote the overall environment and industrial chain of national or enterprise organizations in waterskiing sports.

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THEORETICAL PROOF AND APPLICATION OF EXPERTS WEIGHTING METHOD

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Abstract

The traditional 5-point Likert scale facilitates only addition, but not multiplication or division. To address this drawback, Bao et al. (2015) proposed the "experts weighting method" but omitted a theoretical proof of the method. This study aims to validate the experts weighting method and thus establish its rationality by incorporating a 100- point Likert scale into this method to reduce the limitations of the traditional 5-point evaluation system. The experts weighting method was used to determine the importance score between variables; then, "mathematical induction" was applied to prove that when the scores of all the variables are equal, the score with a higher variance signifies lower importance, thus proving the innovative experts weighting method. The results revealed that the 5-point evaluation system was improved by introducing a 100-point Likert scale. In addition, comparing the multiplication relationship between variables and evaluating the internal variance demonstrated the degree of importance between variables. Therefore, the proposed method could be used for sorting the variables according to importance; hence, the experts weighting method can be used to increase the efficiency for evaluating discrimination.

Keywords: experts weighting method, Likert scale, mathematical induction

Introduction

The Likert Scale is the most widely used approach in survey research, but several researchers showed it has drawbacks. Gliem, J and Gliem, R (2003) claimed that the Likert scale could only differentiate high and low scores; thus, because the scores were not precise, they could not be used for comparison. Jamieson (2004) proposed that, because the Likert scale could not reveal the importance distribution of values, its mean and standard deviation could not be used as the basis for sorting. Gardner and Martin (2007) claimed that the Likert scale was only suitable for sorting and that the values did not have any significant meaning. Norman (2010) proposed that the Likert scale could be used for sorting but that it is unsuitable for statistical analysis. Li (2013) proposed that, because of the equal intervals, the Likert scale may distort the obtained information. Sullivan and Artino (2013) proposed that the Likert scale could sort within a certain range but that the values assigned to the response do not exhibit a multiple relationship. Hartley (2014) proposed that a Likert scale could be used for sorting; however, the mean and standard deviation could not be used as basis for other analyses.

To deal with the limitations of Likert scale, Bao et al. (2015) proposed the innovative experts weighting method. To perform this method, experts are invited to evaluate variables based on their professional knowledge and assign an importance score to the variables using a 5-point Likert scale. The importance scores are then aggregated to obtain an importance analysis for each variable.

The following application of the Likert scale was made on the basis of the aforementioned studies:

Suppose, experts use the 5-point Likert scale for evaluation scores, then the five intervals would be the intervals between the scores 1, 2, 3, 4, and 5. If a 100-point scale is employed, then dividing the scale into five equal intervals would provide intervals of 1–20, 21–40, 41–60, 61–80, and 81–100.

Suppose that Expert A gives variable A a score of 21 and variable B a score of 18, and that Expert B gives the variable A a score of 32 and variable B a score of 40. These two evaluations could result in the following scenarios:

(1) Using the traditional Likert scale, the total scores for variables A and B are 4 and 3, respectively. If the 100-point scale was used, then these scores would be 53 and 58, respectively. The results of the two methods of evaluation differ considerably, and their importance values are opposite. Therefore, the traditional Likert scale could only reveal an approximate evaluation of each variable; further examination would reveal irrational phenomena.

(2) Using the traditional Likert scale, if the aggregate scores of variables A and B are equal, their importance values could not be differentiated. Because the 100-point scale facilitates addition, subtraction, multiplication, and division, the scores for the two variables can be compared using this method, and the variance of each variable could also be computed. If two variables have the same total score, their importance values could be determined on the basis of the variance.

To amend the shortcoming of the 5-point Likert scale, which permits only addition but not multiplication or division, this study employed a 100-point evaluation scale, and experts were requested to evaluate the importance of each variable with 1 as the base to form a matrix β. Then, matrix X was formed by applying the scoring criteria with a maximum of 100 points. By multiplying matrices β and X, the importance matrix T of each variable was obtained. The degree of "override" of variable i over variable j is then obtained from matrix T by dividing the importance of i by the importance of j. If s variables were assessed, s such ratios would be obtained. Thus, the mean importance of variable i is calculated as follows. Divide variable j from matrix T by i to obtain the s relative importance values of matrix $\hat{T}$ for $i = 1,...,s$， $j = 1,...,n'$; then, aggregate the elements in the nth columns of these s matrices $\hat{T}$, sort them according to the matrix $T*$, and transpose the matrix into matrix T^r. Then, use $T*/T^r$ to obtain $T*T^r$. $T*T^r$ can subsequently be used to determine the mutual override relationships between variables. The results showed that the proposed experts weighting method could not only amend the shortcomings of the 5-point Likert scale method, but also illustrate the multiple relationship of each variable and provide a more comprehensive evaluation of each variable on the basis of internal variance, thus enhancing the discrimination between variables. This paper is divided into five sections. Section 2 introduces the experts weighting method. Section 3 introduces the proposed proof and application of the experts weighting method, including the improvement of the traditional Likert scale through mathematical induction to prove the sorting basis for sorting the variables' importance values when their total scores are the same. Section 4 illustrates the proof, and conclusions are drawn in Section 5.

Experts Weighting Method

Bao et al. (2015) proposed the experts weighting method, in which representative, authoritative, earnest, and responsible experts who were familiar with the scoring criteria conducted evaluations and provided appropriate scores within the specified range. In this method, a score is assigned to represent the importance of a variable according to the evaluation by experts on the basis of their professional knowledge; then, the importance of each variable i is divided by the importance of another variable j to obtain the degree of override of variable i over variable j. Suppose that the total number of variables is s; then, the number of ratios would also be s, and thus the mean importance of variable i could be estimated.

Override is defined as follows: The ratio of the importance values of variables i to j is called the override of variable i over variable j.

According to this definition, if the override of variable i over variable j is higher than 1, then the importance of variable i is higher than that of variable j; conversely, if the override of variable i over variable j is less than 1, then the importance of variable i is lower than that of variable j The implementation steps are described as follows:

1. Request that n experts rate the importance values of s variables using the 5-point Likert scale and construct the importance matrix I as follows:

$$X^* = \begin{bmatrix} x_{11}I_{11} & I_{12}x_{12} & . & . & . & I_{1s}x_{1s} \\ x_{21}I_{21} & I_{22}x_{22} & . & . & . & I_{2s}x_{2s} \\ . & & & & & \\ . & & & & & \\ . & & & & & \\ x_{n1}I_{n1} & I_{n2}x_{n2} & . & . & . & I_{ns}x_{ns} \end{bmatrix}$$

2. Divide the variables in row j of matrix I by variable i from the other rows to obtain s relative importance matrices. After aggregating the elements of the n columns of these s matrices, sort them to form matrix T as follows:

$$T = \begin{bmatrix} A_1 & A_2 & . & . & . & A_s \\ B_1 & B_2 & . & . & . & B_s \\ . & & & & & \\ . & & & & & \\ . & & & & & \\ S_1 & S_2 & . & . & . & S_s \end{bmatrix}$$

The elements in the first column of T are the sums of the columns obtained after dividing the elements in the first column of Matrix I by the sum of the other rows; the data for other columns were derived similarly. The values given by t_{ij} in each row signify the importance ratio of the ith variable to the j th variable. A higher t_{ij} indicates a greater degree of override of the i th variable over the j th variable; and t_{rj} signified the degree of "override" of the r th variable by the j th variable, a larger t_{rj} signified that the importance of the j th variable was higher than that of the r th variable.

3. Because the r th variable has some degree of override (t_{rj}) over the j th variable, there is also a degree of override (t_{jr}) by the j th variable. Thus, in the vector

$$\left\{ \frac{t_{i1}}{t_{1i}}, \frac{t_{i2}}{t_{2i}}, ..., \frac{t_{is}}{t_{si}}, i = 1, ..., s, n = 1, ..., n \right\},$$

each element is expressed as the degree override of variable i over variable j divided by the degree of variable i being overridden by variable j The sum of the elements in the i th row signifies relative importance of the i th variable in comparison with the other variables.

Proof and Application of the Experts Weighting Method

The experts weighting method proposed by Bao et al. (2015) used the traditional Likert scale to establish a questionnaire and analyze the importance of each question. However, the traditional Likert scale yielded identical values for the attitude measured for each variable. Aggregating the raters' importance scores for a variable provided its degree of importance. To enable the rated scores to be used for addition as well as multiplication, a small alteration was made to the Likert scale method. When a survey on the importance of the variables was conducted, the respondents assigned an importance weight to the variables (Table 1) and rated the importance on a 100-point scale. The respondents could give the variables an appropriate score at their discretion, enabling respondents to rate the variables' degrees of importance more freely and appropriately. Thus, the importance ratings provided by the respondents were more accurate.

Table 1: Experts' Importance Values for Hygiene, Transport, Ambience, and Taste, With Price as the Base

Experts	Price	Hygiene	Transport	Ambience	Taste
1	1	1.1	1.1	0.9	1.1
2	1	1.2	1.1	1	1
3	1	1.1	1.2	1.2	1.1
4	1	1	1.1	0.9	1.1
5	1	1.2	1.1	1.2	1.1
6	1	1.1	1.1	1.1	1.2
7	1	1.2	1.1	1.1	1.2
8	1	1.2	1.1	1.2	1
9	1	1.1	1.2	1.1	1.1
10	1	1.1	1.2	1	1

Alteration to the Traditional Likert Scale Evaluation

Most studies that have discussed and analyzed the importance values of variables have considered the traditional Likert scale to be the simplest method. In this method, the experts' scores for the variables are aggregated, and the importance of a variable is determined according to this aggregate: the higher the aggregate, the higher the importance. Although this type of evaluation method is straightforward, it has the following shortcomings:

(1) Because the traditional Likert scale supports only addition and not multiplication, this type of scale is also known as an aggregate scale. Therefore, a comparison of the aggregate scores of variables A and B enables only an approximate distinction between high and low scores; the relative importance of these two variables could not be measured using this method.

(2) If the aggregate scores of numerous variables were often identical, then this evaluation method could not effectively compare the degrees of importance of the variables.

(3) Aggregating the scores yields only the mean, and the variables' internal variance cannot be obtained. If the mean difference is not large, then the variance would affect the importance of the variable.

To enhance the accuracy of importance evaluation for variables and to enable the scores on the scale to be aggregated as well as multiplied, this study introduced an enhanced evaluation method. Representative, authoritative, earnest, and responsible experts who were familiar with the evaluation criteria evaluated the importance of the variables by providing an appropriate score within a specific range. The experts were asked to assign a weight to the importance of the variables to construct matrix β. Then, the experts rated the importance of the variables by as-

signing them an appropriate score based on the 100-point scale. These score were used to construct matrix X, and the variables in β were multiplied with those of X to obtain matrix T.

The following scenario was proposed: the manager of a restaurant wanted to evaluate the importance consumers attach to price, hygiene, transport, ambience, and taste. The following steps are performed to provide this information:

Step 1: Invite 10 experts to rate the importance of hygiene, transport, ambience, and food with price as the base. The ratings are shown in Table 1. These ratings are used to form matrix β.

$$\beta = \begin{bmatrix} 1 & 1.1 & 1.1 & 0.9 & 1.1 \\ 1 & 1.2 & 1.1 & 1 & 1 \\ 1 & 1.1 & 1.2 & 1.2 & 1.1 \\ 1 & 1 & 1.1 & 0.9 & 1.1 \\ 1 & 1.2 & 1.1 & 1.2 & 1.1 \\ 1 & 1.1 & 1.1 & 1.1 & 1.2 \\ 1 & 1.2 & 1.1 & 1.1 & 1.2 \\ 1 & 1.2 & 1.1 & 1.2 & 1 \\ 1 & 1.1 & 1.2 & 1.1 & 1.1 \\ 1 & 1.1 & 1.2 & 1 & 1 \end{bmatrix}$$

Step 2: Ask the experts to rate price on a 100-point scale according to their professional knowledge (Table 2). These ratings are used to form matrix X.

$$\text{Let } X = \begin{bmatrix} 58 \\ 73 \\ 58 \\ 58 \\ 79 \\ 58 \\ 58 \\ 57 \\ 76 \\ 75 \end{bmatrix}$$

Step 3: With price as the base, multiply the matrix β variables with those of matrix X. The multiplication signified by "$\circ$" is not typical matrix multiplication but the corresponding element multiplication of the elements of X with the elements of each row of β. The product, matrix T, represents the importance of each variable.

$$T = X \circ \beta = \begin{bmatrix} 58 & 63.8 & 63.8 & 52.2 & 63.8 \\ 73 & 87.6 & 80.3 & 73 & 73 \\ 58 & 63.8 & 69.6 & 69.6 & 63.8 \\ 58 & 58 & 63.8 & 52.2 & 63.8 \\ 79 & 94.8 & 86.9 & 94.8 & 86.9 \\ 58 & 63.8 & 63.8 & 63.8 & 69.6 \\ 45 & 69.6 & 63.8 & 63.8 & 69.6 \\ 57 & 68.4 & 62.7 & 68.4 & 57 \\ 76 & 83.6 & 91.2 & 83.6 & 83.6 \\ 75 & 82.5 & 90 & 75 & 75 \end{bmatrix}$$

The result not only illustrated the strengths of the relationships between variables but also confirmed the presence of multiple relationships. Additionally, mathematical induction was applied to prove that the degree of importance decreased with an increase in variance between variables.

Mathematical Induction

During the experts' evaluation, the same aggregate could be obtained for numerous variables. This study employed the variance of each variable to reveal its implications. Theorem 1 demonstrates that the importance values of variables with the same aggregate are related to their variances.

Before proving Theorem 1, the definition of ideal variable is provided as follows:

Table 2. Experts' Ratings of Price on A 100-point Scale

	1	2	3	4	5	6	7	8	9	10
Price	58	73	58	58	79	58	58	57	76	75

Definition: The ideal variable is a variable for which all experts provided an identical importance score; that is, all experts shared the same opinion on the importance of the variable.

Theorem 1: When the aggregate importance score of variables A and B are identical, but the variance of the importance scores of A is higher than that of B, then A is less important than B.

Proof: Assume that *n* experts provide importance scores for A and B, given by $a_1, a_2, a_3, ..., a_n$ and $b_1, b_2, b_3, ..., b_n$, respectively, that the variance of A is greater than the variance of B, and that the mean score $\bar{a}$ of A is equal to the mean score $\bar{b}$ of B.

If the importance scores of A and B are rearranged in descending and ascending order, respectively, (i.e., $a_1 \geq a_2 \geq a_3 \geq ... \geq a_n; b_1 \leq b_2 \leq b_3 \leq ... \leq b_n$), then, according to the assumption of Theorem 1,

$$(a_1^2 + a_2^2 + a_3^2 + ... + a_n^2 - n\bar{a}^2) > (b_1^2 + b_2^2 + b_3^2 + ... + b_n^2 - n\bar{b}^2).$$

That is,

$$(a_1^2 - b_1^2) + (a_2^2 - b_2^{2)}) + (a_3^2 - b_3^2) + ... + (a_n^2 - b_n^2) > 0$$

Next, assume that an ideal variable was given an importance score of *q* by all experts. Then, when its mean $q = \bar{a} = \bar{b}$ is divided by the importance scores of A and B, the relative scores of the ideal variable to A and B are given as follows:

$\frac{q}{a_1}, \frac{q}{a_2}, \frac{q}{a_3}, ..., \frac{q}{a_n}$ and

$\frac{q}{b_1}, \frac{q}{b_2}, \frac{q}{b_3}, ..., \frac{q}{b_n}$, respectively. Thus,

(1) can be demonstrated through mathematical induction.

$$\frac{1}{a_1} + \frac{1}{a_2} + ... + \frac{1}{a_n} > \frac{1}{b_1} + \frac{1}{b_2} + ... + \frac{1}{b_n}$$

(1)

1. When $n = 1$, because $a_1^2 = b_1^2$, $\frac{1}{a_1} > \frac{1}{b_1}$; thus, (1) holds.

2. Suppose (1) holds for $n = k$. Thus, when

$$a_1^2 + a_2^2 + a_3^2 + ... + a_k^2 > b_1^2 + b_2^2 + b_3^2 + ... + b_k^2$$

,

$$(\frac{1}{a_1} + \frac{1}{a_2} + \frac{1}{a_3} + ... + \frac{1}{a_k}) > (\frac{1}{b_1} + \frac{1}{b_2} + \frac{1}{b_3} + ... + \frac{1}{b_k}) \cdot$$

3. When $n = k + 1$, suppose that the aggregate scores of A and B are identical; then,

$$(a_{k+1} - b_{k+1}) < (a_k - b_{k+1}) < (a_k - b_k) <, ..., < (a_1 - b_1) < 0 \cdot$$

Thus,

$$(a_{k+1} - b_{k+1}) < 0,$$

and hence,

$$\frac{1}{a_{k+1}} > \frac{1}{b_{k+1}}$$

and

$$(\frac{1}{a_1}+\frac{1}{a_2}+\frac{1}{a_3}+...+\frac{1}{a_k}+\frac{1}{a_{k+1}})>(\frac{1}{b_1}+\frac{1}{b_2}+\frac{1}{b_3}+...+\frac{1}{b_k}+\frac{1}{b_{k+1}})$$

Therefore, (1) holds.

4. On the basis of mathematical induction,
$\frac{1}{a_1}+\frac{1}{a_2}+\frac{1}{a_3}+...+\frac{1}{a_k}+\frac{1}{a_{k+1}}>\frac{1}{b_1}+\frac{1}{b_2}+\frac{1}{b_3}+...+\frac{1}{b_k}+\frac{1}{b_{k+1}}$
holds for any natural number n.

The proof of Theorem 1 indicates that, comparing the scores of an ideal variable with those scores of A and B would result in the following aggregate score:

$$(\frac{q}{a_1}+...+\frac{q}{a_k}+\frac{q}{a_{k+1}})-(\frac{q}{b_1}+...+\frac{q}{b_k}+\frac{q}{b_{k+1}})>0 \quad (2)$$

In (2), $(\frac{q}{a_1}+...+\frac{q}{a_k}+\frac{q}{a_{k+1}})$ compares the scores of the ideal variable with those of A. The result is greater than the scores of ideal variable divided by those of B $(\frac{q}{b_1}+...+\frac{q}{b_k}+\frac{q}{b_{k+1}})$. On the basis of comparison with the ideal variable, the importance of A was lower than that of B. Thus, the theorem is validated.

The proof for Theorem 1 reveals that, the aggregate importance scores of each variable and its internal variance should be considered. That is, when the aggregate scores of the variables are identical, the variance of the scores should be computed. Those with higher variance had lower importance than those with lower variance. Section 4 provides an example to illustrate the experts weighting method.

Example

This section employed the matrix T obtained in Section 3. The importance evaluations of the variables are collated as shown in Table 3.

By overriding the variables, the aggregate scores of the variables were determined. The transpose of the matrix of these aggregate scores was then obtained. Dividing the aggregate scores by the transpose matrix of the aggregate scores yielded the mutual override relationships between the variables. In Table 3, the aggregate scores of Hygiene and Transport were identical; however, their variances were calculated as 155.46325 and 146.6077, respectively. Then, the override relationships between these variables revealed that the importance of Hygiene, which had a higher variance, was lower than that of Transport. Thus, this is an application of Theorem 1.Thus, the relative importance relationships between the variables not only enabled comparisons of their scope but also the implementation of multiplication and division calculations. The multiple ratios between the variables could also be compared. This is the proposed improvement on the traditional Likert scale method. However, because equal score situations may still arise using this method of evaluation, the proposed experts weighting method employs mutual override relationships to calculate the scores of each variable in order to enable a clearer depiction of the degrees of importance of the individual variables. Additionally, the evaluation of the mutual override relationships between variables in reveals that consumers assigned the following order of importance to the five factors for the restaurant: Transport > Hygiene > Taste > Ambience > Price.

Table 3. Importance Evaluations Based on the 100-point Evaluation Scale

Experts	Price	Hygiene	Transport	Ambience	Taste
1	58	63.8	63.8	52.2	63.8
2	73	87.6	80.3	73	73
3	58	63.8	69.6	69.6	63.8
4	58	58	63.8	52.2	63.8
5	79	94.8	86.9	94.8	86.9
6	58	63.8	63.8	63.8	69.6
7	45	69.6	63.8	63.8	69.6
8	57	68.4	62.7	68.4	57
9	76	83.6	91.2	83.6	83.6
10	75	82.5	90	75	75
Total	650	735.9	735.9	696.4	706.1

Conclusions

Bao et al. (2015) proposed the application of the experts weighting method but omitted an adequate proof of the theory. This study employed a 100- point Likert scale evaluation method to improve the traditional 5-point Likert scale, which facilitated only addition but not multiplication or division.

To construct and consolidate the theory of the proposed method, this study applied mathematical induction to prove that, during the evaluation of the importance of each variable, the aggregate scores and internal variance of the variables must be considered. That is, when the aggregate scores of the variables are equal, the variances of the variables should be calculated; then, a higher variance signifies less importance. Thus, the 100-point experts weighting method could be used to compare the scope of the scores and the multiple relationships between the variables; the degree of importance between the variables can be obtained through the evaluation of internal variance. The results demonstrated that the aggregate scores for Hygiene and Transport for the restaurant were equal. After calculating the variances of Hygiene (155.46325) and Transport (146.6077), the various override relationships indicated that the importance of Hygiene, which had higher variance, was lower than that of Transport. Thus, the degrees of importance of the variables were demonstrated through the evaluation of internal variance, which is the application of Theorem 1. Thus, the importance levels of the variables could be used for sorting the variables, and the experts weighting method enhanced the efficiency of discrimination. In summary, a scientific or evaluation method was used to alter the method for the evaluation of the degrees of importance of variables. Further studies are required to enhance the efficiency discrimination between variables.

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EXPLORATION OF APPLICATION FOR E-BOOKS IN ELEMENTARY SCHOOL DISASTER PREVENTION EDUCATION

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Abstract

In this study, ADDIE was used to design the disaster education e-book and Smart Apps Creator was used to produce the ebook. The research method was quasi-experimental research.27 elementary students participated in the experimental group and 38 were in the control group. The students in the experimental group learned disaster education by reading e-book while the ones in the control group learned by reading texts on paper version. Differences and changes in the disaster knowledge, attitudes, and skills between the two groups were discussed. The research indicated the following results and findings:1. The use of ADDIE in designing and making disaster education e-book was practical.2. The use of e-book was helpful for broadening school children's knowledge of disaster education.3. The use of disaster education ebook had no remarkable influence on promoting schoolchildren's attitudes or skills of disaster education.4. School children showed positive attitudes towards learning disaster education by reading disaster education ebooks.

According to the results of the study, disaster education ebooks are supposed to be implemented with disaster activities. The broadening and deepening of disaster education ebooks as well as the involvement of qualitative research can be considered in future studies.

Keywords: eBook; evaluation (ADDIE); disaster prevention education

Introduction

All manuscripts must be in English, also the table and figure texts, otherwise we cannot publish your paper. Because of global climate change, severe natural disasters such as rainstorms, earthquakes, and tsunamis have become increasingly frequent, causing ever greater losses in lives and properties. Consequently, public disaster-prevention awareness has increased.

The World Disaster Reduction Campaign of the United Nations promoted a project named Disaster Risk Reduction Begins at School between 2006 and 2007, foregrounding the importance of implementing disaster prevention education in schools [1]. In 2004, the White Paper on Education of Disaster Prevention published by the Taiwan Ministry of Education (MOE) indicated that disaster prevention education emphasizes actual actions, of which increasing disaster-related knowledge is also a key point [2]. More implementation strategies were proposed in "Strategies of the Implementation of Disaster Prevention Education," such as strengthening the idea of and knowledge on disaster prevention and relief education, accumulating knowledge on disaster prevention and relief, developing disaster prevention education courses and teaching materials, and promoting the idea of disaster prevention education [3].

In addition to establishing campus-wide disaster warning and notification mechanisms, propaganda on earthquake, fire, and other disaster prevention education and school-wide evacuation drills have also been implemented. However, besides providing formal courses, elementary and junior high schools are required to promote and advocate additional information and procedures. The time that can be allocated to disaster prevention education is very limited.

The prevalence of the internet and mobile devices in recent years has changed people's living habits as well as the methods of learning and data retrieval. Consequently, digital learning has also been applied in education. In recent years, using multimedia eBooks to effectively communicate learning content and enhance learning motivation has become widely researched in popular science and science education [4].

If disaster prevention education materials can be implemented in interactive eBooks, teachers can implement disaster prevention education in formal course sessions, and students can study these materials by themselves when in-class disaster prevention education is not provided because of limited time. In addition, the interactive reading interface of eBooks can enhance students' learning interests.

This study created a disaster prevention education eBook to develop disaster prevention knowledge, attitudes, and skills of elementary school children by encouraging students to read the proposed eBooks. Consequently, this study investigated the following questions:

1. How can disaster prevention eBooks that use the analysis, design, development, implementation, and evalua-

tion (ADDIE) instructional design model be created with the Smart Apps Creator software?

2. What are the influences of reading disaster prevention eBooks on elementary school students regarding their disaster prevention knowledge, attitudes, and skills?

Literature Review

Current status of domestic and international disaster prevention education

Chiang (2004) noted that the key points of US public disaster-prevention education are disaster awareness, community integration, preparedness prior to the occurrence of a disaster, and the provision of technical information and emergency response plans. The disaster prevention education of current students is implemented by their affiliated schools. Governmental departments, academic research units, and other disaster relief- emergency response organizations assist in designing the content of related courses [2]. In terms of disaster prevention training of education personnel, the United States emphasizes professional training, and dedicated agencies are responsible for such training and education. Moreover, according to the reviewed criteria, the trainees must pass related tests to pass the course or obtain related certificates [5].

For disaster prevention education implemented at the school level, preparedness prior to the occurrence of a disaster and response measures are the two essential educational points advocated in Japan [2]. Chen (2013) investigated Japanese citizens' attitudes toward and preparations for natural disasters and found that disaster prevention strategies are promoted as early as the preschool period. Evacuation training is conducted in kindergartens approximately once per month to teach young children evacuation principles of "no speaking, no running, and no pushing" [6]. Wang (2010) also indicated that in Japan, disaster prevention education is included in formal curriculum guidelines; consequently, disaster prevention courses that correspond to student age have been developed [7].

In the United Kingdom, disaster prevention education is incorporated in curriculum standards, focusing on human factors and behaviors as well as an analytical review of natural disasters. In Australia, school education is employed as a medium for realizing the strategic objectives of disaster prevention education. Disaster effects and disaster prevention messages are integrated in school curricula to enhance the awareness of the community regarding disaster prevention and preparation [2].

In terms of the implementation of disaster prevention education in Taiwan, the MOE has invited academic institutions with experience in disaster prevention and relief to jointly implement projects such as "Disaster Reduction Education" (2003–2006), "Technological Disaster Prevention Education and Subsoil Experiment Research and Development Programs" (2007–2010), and the "On-campus Disaster Prevention Facility Project" (2011–2014). These projects were expected to develop disaster prevention knowledge, attitudes, and skills in students and teachers, thereby ensuring that students of every age group would receive disaster prevention education to further strengthen the disaster

prevention capacities of society. Disaster-prevention education has been promoted through a progressive process involving talent cultivation, development of teaching materials, and the establishment of localized disaster-prevention campus environments, eventually forming a network of disaster preventive campuses. Currently, the "School Disaster Prevention and Climate Change Adaptation Education Promoting Programs" are being implemented (2015–2018) to enhance the disaster prevention literacy of all citizens in various aspects [8].

Research Directions of Disaster Prevention Education in Taiwan.

Disaster prevention education in Taiwan comprises three directions:

The first direction involves developing and analyzing standards or scales of disaster prevention knowledge, attitudes, or skills. For example, Liao (2006) developed scales of preventive disaster education for grade 1–9 students [9], and Liao (2011) assessed the performance of primary school students in terms of disaster prevention skills [10].

The second direction involves discussing the effects of different teaching methods on students' disaster prevention knowledge, skills, and attitudes. For instance, Hsu, Wu, and Wang (2009) investigated the effect of a learner- centered teaching program of debris flow disaster prevention for students in higher grades at primary school [11], and Chen (2014) proposed the research and creation of an educational game related to disaster prevention [12].

The third research direction involves disaster prevention education projects that apply computers and other multimedia tools. For example, Chen (2006) recruited third grade students for examining the effects multimedia- assisted seismic hazard mitigation instructions [13]. Wang (2010) recruited fifth grade students at an elementary school in New Taipei City for examining the effects of disaster prevention education with WebQuest [14].

The present study used eBooks to promote disaster prevention education; therefore, it should be categorized in the third direction, namely studies that apply computers and other multimedia tools. Applications of Multimedia eBooks in Education. Most Taiwanese studies on the influences of multimedia eBooks on students' learning motivation have reported positive and significant results. Cho (2013) indicated that students exhibited higher learning motivation when using multimedia materials than when using printed materials [4]. Other studies have found that integrating eBooks into teaching enhances student learning. Su (2013) claimed that using e-diaries improved students' diary writing ability, thus enhancing students' competency in writing [15]. In addition, teaching designs that properly incorporate eBook properties can improve student learning in various fields. For example, Yu (2014) applied eBooks in a math unit, "Volume and Volume" [16], whereas Wu used eBooks in elementary school arts and humanities courses [17]. Consequently, the present study created a disaster prevention education eBook on the basis of appropriate teaching and eBook design with the intention to implement the proposed eBook in classroom education.

In the Taiwan e-Learning and Digital Archives Program, e-learning is defined as learning activities conducted online or offline by using digital tools and wired or wireless internet to obtain digital teaching materials. According to this definition, learning using eBooks can be regarded as a form of e-learning. The purpose of e-learning is to provoke learners' interests in conducting subsequent learning activities. Therefore, user acceptance is a key factor. With the technology acceptance model (TAM), Davis (1989) asserted that external factors can affect users' personal beliefs, which further influence the users' attitudes, intentions, and eventually their utilization of information systems. Personal beliefs in the TAM include the dimensions of perceived ease of use (PEU) and perceived usefulness (PU) [18].

The present study also analyzed the students' intention to use the eBook according to these two dimensions. On the basis of the aforementioned studies and the aim of the present study to implement disaster prevention education, an eBook comprising textual descriptions and images was created to form an interactive interface and assist in developing students' learning interests. In addition, PEU was considered when creating the eBook to reduce the time the students' would have to spend on learning to operate and use the interface so that the students can focus on learning the content.

Research Methods, Steps, and Analyses

Design of the eBook

This study applied the ADDIE instructional design model to design the disaster prevention eBook. The design steps are presented as follows.

First, information and materials relevant to disaster prevention education were collected, disaster prevention knowledge and literacy that students in the third to sixth grade should possess were analyzed, and the functions and advantages of the eBook creation software Smart Apps Creator were explored. In this study, the eBook was used as a supplement to the disaster prevention education provided in schools. To enable students to read the eBook by themselves and apply the disaster prevention knowledge they learned to their lives, the data collected mainly consisted of the content of disaster prevention education for third graders and fourth graders; a portion of the content of disaster prevention education for fifth graders and sixth graders was included as supplementary content, in which the relatively difficult theoretical content (e.g., causes for typhoons and factors for fire accidents) were omitted. Because of the students' limited concentration in reading, the eBook was expected to be read in 15–30 min; therefore, the eBook was restricted to contain approximately 20 pages.

The design of the disaster prevention eBook was based on the premise that elementary school children should be able to finish the eBook in a short time. The content focused on three major items promoted at school: the prevention of damage caused by earthquakes, typhoons and floods, and fires. Appropriate images collected were included in the eBook. In consideration of students' limited concentration span, each page of the eBook contained reading passages or interactive activities that

could be clicked on to enhance students' concentration.

When developing the disaster prevention eBook, the researchers first familiarized themselves with the functions of the eBook creation software, the Smart Apps Creator. Subsequently, the content of the disaster prevention education teaching materials was produced. In addition, a few teachers and students who aided the research used the EBook in advance to ensure that other students could operate the eBook.

When the disaster prevention eBook was employed in the formal teaching experiment, the homeroom teacher of the experimental group demonstrated how to use the disaster- prevention eBook, thereby reducing the time required for students to learn how to use the eBook. When operational problems occurred, the homeroom teacher helped eliminate the problems to facilitate the progression of the reading activity. Finally, a posttest questionnaire was administered to the students. The results served as a user assessment of the disaster prevention eBook, which could also be applied as a reference for future revisions of the content and operations of the eBook.

Research Participants

This study recruited students from the third to sixth grade at an elementary school in Changhua County, Taiwan as the research participants. The experimental group comprised 27 students and the control group consisted of 38 students; a total of 65 students participated in this study. The researchers selected school classes as the research participants by using purposive sampling. To maintain the research focus, influences of the digital learning gap caused by family background factors and the use frequency of information equipment were not discussed in this study.

Experimental Process

This study adopted a quasi-experimental method. Participants in the experimental group were provided with the disaster prevention eBook developed by the researchers (Figure 1). The eBook was designed using the ADDIE instructional design model. By comparison, participants in the control group were assigned to read identical content, except that the content was edited in the form of textual descriptions and image captions, and was printed as hard copies to be distributed to the control group students (Figure 2). The proposed disaster prevention education teaching materials focused on preventing damage caused by earthquakes, typhoons and floods, and fires.

The content mainly referred to disaster prevention education teaching materials available on the Digital Platform for Disaster Prevention Education, MOE (Student Learning Manual of the Disaster Prevention Teaching Materials for Grade 1–9 Curriculum) [8]. Other references for the disaster prevention eBook and its corresponding hard copy for reading as well as the pretest and posttest questionnaires included the Handbook of Reference for Responsive Procedures to Disasters, the White Paper on Education of Disaster Prevention for the standard on the disaster prevention literacy elementary school students should possess [2], and the Scales of Preventive Disaster Education for Grade

Figure 1. Interactive page of the disaster prevention eBook

Figure 2. Hard copy of the disaster prevention education materials provided to the control group

1–9 Students developed by Liao (2006). The experiment spanned approximately two weeks, which comprised a pretest, the experiment intervention (reading activity of disaster prevention education materials), and a posttest. The pretest was implemented seven days prior to the reading activity. The experiment was conducted by the homeroom teachers of the tested classes during their class sessions. The implemented time periods and the reading time allocated to the ex-

perimental and control groups were identical. The posttest was conducted two days after the reading activity. Regarding the collection and analysis of statistical data, a pretest was administered prior to the reading activity to evaluate students' disaster prevention knowledge, attitudes, and skills. After the experiment intervention, a posttest was administered. The data obtained in the posttest were employed to analyze the effects of reading different presentations of disaster prevention education material, namely the disaster prevention eBook and its corresponding hard copy, on student knowledge and learning interests concerning disaster prevention education. In addition, participants in the experimental group were asked to complete an additional questionnaire on the use intention of the disaster prevention eBook; the results were employed to analyze the technology acceptance of eBook reading.

Data Processing

The questionnaires were coded according to the order in which they were returned. Because of the relatively small size of the research sample, the pretest and posttest questionnaires were coded in two digits, starting from "01." Of the 65 pretest questionnaires distributed, 64 valid questionnaires were returned. All valid pretest questionnaires were coded from 01 to 64. All 65 distributed posttest questionnaires were returned valid; hence, they were coded from 01 to 65. After the questionnaires were coded, the information on the questionnaires was converted into numeric values and input into Excel spreadsheets. A quantified data analysis was performed using the statistics function of the Excel software.

Verification and Discussion of Empirical Results

This study developed a disaster prevention eBook and investigated the effects of reading the disaster prevention eBook on elementary school students' disaster prevention knowledge, attitudes, and skills. The results are discussed according to the following aspects: the design and creation process of the disaster prevention eBook, the effects of different modes of reading on students' disaster prevention knowledge, the effects of different modes of reading on students' disaster prevention attitudes and skills, and student acceptance of reading the disaster prevention eBook.

1. Design and Creation Process of the Disaster Prevention eBook

This study followed the ADDIE instructional design model to design the disaster prevention eBook. The design process is represented in the following steps:

Analysis (A): Analysis of the disaster prevention knowledge and literacy. Content presented for each key disaster item is shown in Table 1.

Design (D): When designing the disaster prevention eBook, materials collected were rearranged and focused on three key disaster items, namely earthquakes, typhoons and floods, and fires. The eBook was designed to be approximately 20 pages in length; each item accounted for six or seven pages. Because the Smart Apps Creator could be used to easily produce interactive interfaces, the main design axis of the eBook involved creating interactions between words and images during operation.

Table 1. Key Disaster Prevention Items And Their Related Content Presented In The Disaster Prevention eBook

Key disaster items	Content presented in the disaster prevention eBook
Earthquakes	1. Causes of earthquakes 2. Damage caused by earthquakes 3. Evacuation and response measures for earthquakes 4. Disaster supply kit
Typhoons and floods	1. Typhoon forecasts 2. Interpreting the meteorological data of typhoons 3. Damage and influences caused by typhoons 4. Disaster prevention and response measures for typhoons
Fires	1. Fire prevention 2. Response measures for fires 3. Methods for asking for help when trapped in a fire site 4. Handling clothes that are on fire 5. Escaping fire sites

Development (D): When developing the eBook, audio and video files were deleted to maintain an eBook file size of approximately 100 Mb.

Implementation (I): At the beginning of the eBook reading activity, the homeroom teacher of the experimental group explained the steps to install the eBook and precautions during operation to the class. The eBook reading activity was 40 min long and comprised two steps: the teacher's explanation of eBook installation and operation, and the students' operation for reading.

Evaluation (E): The evaluation was conducted using the students' posttest questionnaire that they completed after reading the disaster prevention eBook. The results can serve as references for revis-

ing the eBook and developing research suggestions.

Effects of Different Modes of Reading on Students' Disaster Prevention Knowledge.

The pretest and posttest questionnaires on disaster prevention literacy comprised 10 questions. Students gained one point for correctly answering one question; the total possible score was 10 points. Of the 10 questions, four tested earthquake-related knowledge, three tested typhoon- and flood-related knowledge, and four tested fire-related knowledge. The total possible score was 10 points. The students' total score on the knowledge questions in the pretest and posttest questionnaires were compared. In the experimental group, the average total score improved from 7.41 to 8.26, exhibiting a rate of increase of 11.5% ([8.26−7.41]/7.41 = 11.5%). In the control group, the average total score improved from 7.68 to 8.34, reaching a rate of increase of 8.6% ([8.34−7.68] /7.68 = 8.6%). The results verified that reading both the disaster prevention eBook and its corresponding hard copy enhanced students' disaster prevention literacy. Furthermore, reading the disaster prevention eBook generated a greater positive effect than did reading its corresponding hard copy.

Effects of Different Modes of Reading on Students' Disaster Prevention Attitudes and Skills

For the attitude- and skill-related questions on the disaster-prevention literacy scale, a 5-point Likert scale was adopted for the assessment. The scale ranged from 5 (strongly agree) to 1 (strongly disagree). Relatively high total or average scores entailed relatively positive disaster prevention attitudes or skills

The students' total scores for the attitude-related questions in the pretest and posttest questionnaires were compared. In the experimental group, the average total score dropped from 42.93 to 42.00, exhibiting a rate of decrease of 2.2% ([42.93−42.00]/42.93 = 2.2%); the standard deviation rose from 3.66 to 4.91, representing an increased difference in disaster prevention attitudes. In the control group, the average total score rose from 42.93 to 42.00, exhibiting a rate of increase of 0.09% ([42.82−42.78] / 42.78 = 0.09%); the standard deviation also increased from 5.16 to 5.26. The variation extent in the total score of both the experimental and control groups was not significant. This finding suggests that different modes of reading (i.e., reading the disaster prevention eBook or its corresponding hard copy) did not exert a positive effect on the students' disaster prevention attitudes.

The students' total scores on the skill-related questions in the pretest and posttest questionnaires were compared. In the experimental group, the average total score rose from 41.81 to 41.93, exhibiting a rate of increase of 0.3% ([41.93−41.81]/ 41.81 = 0.3%). In the control group, the average total score rose from 42.68 to 43.76, exhibiting a rate of increase of 2.5% ([43.76−42.68]

/42.68 = 2.5%). For both group of students, the total score for the skill-related questions increased slightly. Moreover, students who read the corresponding hard copy of the disaster-prevention eBook showed a slightly greater increase in scores than did students who read the disaster prevention eBook. However, the extent of score increase was not sufficiently significant to suggest that reading the disaster prevention eBook or its corresponding hard copy improved students' disaster prevention skills; the finding did not evidently support that reading the corresponding hard copy exerted a more satisfactory effect on improving students' disaster prevention skills than did reading the disaster-prevention eBook.

Student Acceptance of Reading the Disaster Prevention eBook

The acceptance analysis on the disaster prevention eBook was conducted in the present study by using the TAM model, which was developed in accordance with previous research: students' PU and PEU of digitalized teaching material used in online courses (Chang, 2002) [21] and the original questionnaire of the TAM model (Davis, 1989). A 5-point Likert scale was adopted for the disaster prevention eBook use-intention questionnaire. The scale ranged from 5 (strongly agree) to 1 (strongly disagree). The questionnaire comprised two dimensions, namely PU and PEU. Of the returned questionnaires, the average score of all items for the PU dimension was 3.81; the average score of individual items ranged between 3.70 and 3.93. The results indicate that the students' cognitive and perceptive evaluations on the PU of the eBook were positive. For individual items, the students' perception scores on the item "eBooks rendered my learning activity relatively easy" were relatively low, indicated that the students had possibly encountered difficulties or inconveniences when reading or operating the eBook. The students' perception scores were highest on the item "eBooks enabled me to acquire more learning content while maintaining the effects of learning," indicating that the students considered reading eBooks helped them learn more content and maintained their learning performance. The students' perception scores on the item "eBooks can improve my learning outcome" were relatively low. Therefore, this study inferred that learning disaster prevention knowledge by reading a disaster prevention eBook does not enhance student learning. The average score of all items in the PEU dimension was 3.80; the average scores of individual items ranged between 3.70 and 4.00. The results indicate that the students' cognitive and perceptive evaluations on the PEU of the eBook were positive. The students' scores on the item "I accept using eBooks in learning activities" was the highest among all items, suggesting that the students accept using an eBook to learn about disaster prevention. However, the students scored relatively low on two items, "I think the eBook operation is easy to learn" and "I think eBooks are easy to use," indicating that inconveniences remained in the operation of the proposed disaster prevention eBook.

Because students required time to familiarize themselves with the interface of the eBook, their use intention was likely reduced. Inconveniences in the operation of the eBook also led to relatively low scores on the item "eBooks rendered my learning activity relatively easy."

Regarding the average scores of all items in the PU and PEU dimensions, the item "I accept using eBooks in learning activities" achieved the highest score (4.00). According to the demographic data of the students, this study inferred that their high acceptance of using eBooks in learning was likely due to their familiarity with information technology. However, other items such as "eBooks can improve my learning," "eBooks rendered my learning activity relatively easy," "I think eBook operation is easy to learn," and "I think eBooks are easy to use," had relatively low scores in students' perceptions. To enhance students' confidence and retain their use intention for eBooks, future revisions of the eBook should emphasize optimizing the user interface to enhance its user friendliness as well as improving the quality of the eBook's content.

Conclusions

On the basis of the research objectives and questions investigated, the research results and findings were compiled and summarized. Three conclusions were reached: 1) Using the ADDIE instructional design model to design and create disaster prevention eBooks is feasible. 2) Reading a disaster prevention eBook facilitates the enhancement of students' disaster prevention knowledge; however, this behavior does not improve students' disaster prevention attitudes and skills. 3) Students exhibit a positive attitude toward using eBooks to learn about disaster prevention.

The second conclusion of the present study indicates that reading a disaster prevention eBook facilitates the enhancement of students' disaster prevention knowledge, but does not improve students' disaster prevention attitudes and skills; this conclusion is different from the those proposed by Chang (2012) and Chen (2006), who both maintained that digital learning methods facilitate the enhancement of students' disaster prevention attitudes and skills [22] [13]. This inconsistency requires further investigation.

Koichi Shiwaku, Rajib Shaw, Ram Chandra Kandel, Surya Narayan Shrestha and Amod Mani Dixit showed that current school disaster education which is based on lectures can raise risk perception, but it cannot enable students to know the importance of pre-disaster measures and to take actual action for disaster reduction. Self education is effective for realizing the importance of implementing measures. Community plays the essential role for promoting students' actual actions for disaster reduction. Future disaster education in school should be active learning for students. Continuous community involvement is the most important factor for school disaster education [23]. This method will fill the theoretical and prac-

tical gaps of elementary school disaster prevention education.

Finally, expanding the content of eBooks, adding video clips to eBooks, or using multiple methods to present the content of eBooks can enhance students' interest in reading eBooks. These findings can serve as references for refining and revising the proposed eBook for application in disaster prevention education.

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CORPORATE SUSTAINABILITY REPORTING AND FIRM VALUE: EVIDENCE FROM A DEVELOPING COUNTRY

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Abstract

Engaging in sustainability activities and their disclosures are common in the recent business setting around the globe. It is therefore vital to explore the consequences of sustainability disclosure. Consequently, the aim of this paper was to discover whether corporate sustainability disclosure has a potential impact on the market value in a developing country. The data was collected from 220 companies listed in the Colombo Stock Exchange (CSE) in Sri Lanka over a period of four years. Regression analysis was executed on the panel data to achieve the study objective. The results revealed a positive relationship between sustainability reporting (SR) and firm market value, accepting the value-enhancing theory. This finding suggests that investors pay a premium in the capital markets for firms that perform in an environmentally and socially responsible manner, compared to firms do not perform in a similar manner. This study contributes significantly to the extant literature by broadening the geographical context, which generally has been excluded from corporate disclosure studies.

Key words: corporate sustainability reporting, firm value, panel data, Tobin's Q, value-enhancing theory

Introduction

Scholars use corporate social responsibility (CSR) and sustainability (and reporting) as interchangeable concepts (Montiel, 2008). The core underlying reason for SR is to convey to the public both the transparency and accountability of the firm in the conduct of its affairs (Godha & Jain, 2015). Engaging in sustainability activities can be a costly exercise for a firm (Bhatia & Tuli, 2015). Even

though sustainability information disclosure may prove costly to a firm in the short-run, it provides many benefits over the long-run. By engaging in CSR activities, a firm enjoys a set of direct and indirect benefits. A firm benefits directly in the shape of cost and risk reduction, while indirectly in the way of competitive advantages. In a wider sense, firms turn out to be more attractive to investors by exhibiting CSR (Carroll & Shabana, 2010). Further, there is evidence that SR improves internal processes, engages stakeholders and persuades investors, all of which contribute to enhance shareholders' value in different ways (Godha & Jain, 2015).

Firms eventually tend to disclose sustainability information voluntarily. Firms do this due to two reasons (De Villiers & Marques, 2016). The first reason is to conform to social expectations and thereby ensure continuous access to resources and markets (i.e. customer support, labor and financial capital). The second reason is to provide additional information that permits capital market participants to more precisely assess firms' financial forecasts and risk profiles, potentially leading to higher share price and higher firm value (Moser & Martin, 2012). Consequently, SR firms are appraised by capital market participants who will then appreciate that investing in SR is a strategy for obtaining business legitimacy and also a method of creating value-relevant information (Lo & Sheu, 2007). Accordingly, the objective of this study is to examine the association between SR and firm value.

Literature Review

Social and environmental reporting as an additional disclosure mechanism has attracted increasing interest from accounting researchers, due to the role that reporting plays in firm valuation (Moser & Martin, 2012). SR is the outcome of investing a significant amount of resources and therefore examining its value-relevance is imperative (Kuzey & Uyar, 2017). Over the years, investors' awareness of sustainability as a viable corporate strategy has grown considerably. Investors, being the key stakeholders in firms, have a need for different types of information. But research to date can show only limited evidence that shareholders recognize social, environmental and sustainability engagements as vital needs, particularly outside the USA (Yu & Zhao, 2015). Jo and Harjoto (2011) also emphasized that CSR has continued to be a highly interesting subject from the viewpoint of whether CSR investments are value-creating, value-destroying, or even value-irrelevant. The debates about responsibility reporting continue to grow without reaching a clear consensus on its meaning or value.

In line with the literature, researchers suggest that causality runs from SR to firm value. Alternatively, an argument about reverse causality direction, that is, from firm value to SR can be assumed. But, such an argument in reverse is less plausible since there is no theoretically sound argument that posits why firms with higher firm value would disclose greater sustainability information. As in common with literature, researchers rely on theory to provide the rationale for hinting at causality. The impact of SR on firm value is based on two alternative theories (Yu & Zhao, 2015). The value-

enhancing (also known as the value-creating) theory on sustainability contends that integration of both environmental and social responsibilities into corporate strategies and practices decreases firm risk, thereby promoting long-term value creation. Yu and Zhao (2015) documented that sustainability is emerging as a critical strategy for minimizing conflicts among various stakeholders, resulting in less risky corporate behavior and stable growth. Thus, the lack of a long-term view of environmental and social sustainability may limit a firm's future growth opportunities. Besides, sustainability engagement reduces the information asymmetry (Cho, Lee, & Pfeiffer, 2013), which renders the firm less likely to engage in corporate tax aggressiveness (Lanis & Richardson, 2012). On the whole, sustainability engagement helps firms to maintain their positions within the market on a long-term basis, thereby opening the doors to better investment packages (Yu & Zhao, 2015). Thus, the value enhancing theory encapsulates the idea that a firm that discloses sustainability information will have a higher market value than a comparable nondisclosure firm. Supporting this view, Cheung et al. (2010) affirmed that there is a positive and significant relationship between SR and market valuation among Asian firms. Some other researchers also conclude that sustainability engagement positively influence firm value (De Villiers & Marques, 2016; Jo & Harjoto, 2011; Lo & Sheu, 2007; Yu & Zhao, 2015). By conducting a study based on the listed firms in Turkey's emerging market, Kuzey and Uyar (2017) also declared that sustainability disclosure proved value relevant in their research setting. The foregoing findings present sufficient evidence to support the view that being sustainable helps a firm to increase its value.

Opposed to this view, proponents of the value-destroying theory (also known as shareholder expense theory) suggest that switching from the pursuit of profit to ethical concerns can impair opportunities to maximize the shareholders' profit (Yu & Zhao, 2015). They believe that sustainability engagement can lead to a diversion of resources and investment in other activities that would not be in the best interests of shareholders. Based on this argument, implementation of sustainability strategies may not be cost-effective and therefore, it is more likely to diminish the value of a firm (Yu & Zhao, 2015). A similar idea was set forth by Barnea and Rubin (2010) using a US sample. They argued that a firm's managers (and block holders) may tend to over-invest in social responsibility activities at the cost of shareholders for their private benefit and to build up their reputation as socially responsible executives. Consistent with this theory, Crisóstomo, Freire and Vasconcellos (2011) documented that CSR had a value-destroying effect in Brazil since a significant negative correlation between CSR and firm value was observed there. Caught between these two opposing arguments, the researchers could not come up with a clear idea regarding the trend of the association between firm value and SR. Consequently, the following hypothesis is developed.

H_1. Sustainability reporting has a significant impact on firm value

Methods

The sample was comprised of

220 firms that were publicly listed on the CSE from 2012 to 2016, producing a total sample of 880 firm-year observations. The sample represented 81 percent of the total population. The remaining 19 percent of firms was excluded because of missing annual reports, incomplete information, late listing and discontinued operations during the given period.

Measurements

The independent variable SR was measured as a binary variable, which was scored "0" if a particular company did not publish a sustainability report and as "1" if the company issued a sustainability report. Since all firms did not publish stand-alone (separate) sustainability reports, the annual reports were examined and checked to see whether they contained sustainability information or not. As is normal in the emerging markets, Sri Lankan firms are not compelled to disclose sustainability and related information. Therefore, firms voluntarily disclose this information without following any particular standard or uniformity in format. Crisóstomo et al. (2011) also pointed out that most of the researchers who use data from the emerging markets struggle to measure the social and environmental disclosures, due to various reasons such as the voluntary nature of disclosure, lack of uniformity in reporting format and the absence of standard guidelines. Unfortunately, sufficient data was not available to develop a sustainability index even for the firms that have been recognized for their sustainability disclosure policies. Thus, following the prior studies (Kuzey & Uyar, 2017; Lo & Sheu, 2007; Yu & Zhao, 2015), the SR variable was operationalized as a binary variable

Firm value was measured by Tobin's Q, which was defined as the ratio of the firm's market value to its accounting (book) value (Crisóstomo et al., 2011). To explain the firm value for sustainability information purpose, firm value was measured as the Tobin's Q. Notably, accounting, economic, and finance literature recognize that Tobin's Q is the widely used proxy for firm value (Crisóstomo et al., 2011; Jo & Harjoto, 2011), which is a market-based indicator. The measure of firm value using Tobin's Q is preferred more, since it is less affected by managerial manipulation and different accounting methods compared to other accounting measures (Omar & Zallom, 2016). Given that SR is not the sole factor that influences firm value, a few variables have been incorporated as controls as suggested by previous studies. It regressed Tobin's Q on a range of variables corresponding to the hypothesis, including firm size (FSZ), which proxies as the logarithm of total assets, leverage (LEV) which is the indicator of a firm's financial structure (Cheung et al., 2010; Crisóstomo et al., 2011; Jo & Harjoto, 2011; Kuzey & Uyar, 2017; Lo & Sheu, 2007; Yu & Zhao, 2015), firm's performance (Cheung et al., 2010; Kuzey & Uyar, 2017; Lo & Sheu, 2007) which is measured in terms of return on equity (ROE), sales growth (SG) which is measured as a percentage of one-year sales change (Cheung et al., 2010; Jo & Harjoto, 2011; Lo & Sheu, 2007), and firm age. Besides, year dummies also acted as controls following the previous studies.

Results

Variables with continuous values were winsorized at the top and bottom one percent (1%) of their distribution, to diminish the effects of extreme values in OLS regression. Descriptive statistics of the variables used in the estimation of model (1) are presented in Panel A of Table 1.

Table 1. Results of Descriptive Statistics and Correlation Analysis

Panel A: Descriptive Statistics

	Mean	Median	Standard Deviation	Tolerance	VIF
Tobin's Q	0.91	0.69	0.70		
SR	0.63		0.48	0.934	1.071
FSZ (Ln)	22.02	22.10	1.51	0.835	1.197
LEV	0.40	0.37	0.30	0.823	1.216
ROE	0.09	0.09	0.11	0.862	1.160
Sales growth (%)	0.09	0.07	0.22	0.907	1.102
Age	2.95	3.14	0.88	0.923	1.083

Panel B: Correlation Matrix

	Tobin's Q	SR	FSZ	LEV	ROE	SG	Age
Tobin's Q	1						
SR	.170**	1					
FSZ	-.232**	.098**	1				
LEV	-.428**	.162**	.343**	1			
ROE	.198**	.175**	.227**	.097**	1		
Sales growth	.120**	.154**	.039	.094**	.270**	1	
Age	.243**	-.078*	-.122**	-.248**	-.060	-.083*	1

Note: N =880; *, ** indicate statistical significance at the 0.05 and 0.01 level respectively (2-tailed tests).

Tobin's Q as the proxy of firm value has a mean value of 0.91. SG has an average of 0.09. The median and standard deviation for Tobin's Q are 0.69 and 0.70 and for SG 0.07 and 0.22 respectively. The mean and standard deviation for SR are 0.63 and 0.48 respectively. The mean values for the rest of the variables are 22.02, 0.40, 0.09 and 2.95 for FSZ, LEV, ROE and firm age, respectively. The highest variance inflation factor (VIF) value of 1.216 suggests that collinearity among variables is very low, indicating that there is no chance of a multicollinearity issue. This argument was reinforced by the tolerance values as well. The tolerance values of all the variables were very high (> 0. 823). The Pearson correlation among the variables is shown in Panel B of Table 1. As hypothesized, SR has a significant association with the firm value. The result confirmed there is a positive association between SR and firm valuation in Sri Lankan firms, suggesting that firms that act in socially responsible ways are more likely to have a premium value. This finding was further validated by the regression analysis results (Table 2). It also shows that all the control variables have significant correlations with the dependent variable at the alpha level of 0.01.

Table 2: Panel Data Analysis Results – Relationship between SR and Tobin's Q

	Pooled OLS		Fixed Effects	
	Coefficient	P (Sig)	Coefficient	P (Sig)
Observations	880		880	
No. of groups			220	
Intercept	2.065	0.000	6.570	0.000
SR	0.306	0.000	0.205	0.000
FSZ	-0.070	0.000	-0.267	0.000
LEV	-0.955	0.000	-0.596	0.000
ROE	1.393	0.000	0.590	0.000
Sales growth	0.267	0.004	0.102	0.097
Age	0.131	0.000	0.085	0.522
Year effect	Yes		Yes	
R^2 - overall	0.3386		0.1954	
F-test				
χ^2		12.11		
Prob.		0.0000		
Hausman test				
χ^2		43.80		
Prob.		0.0000		

Panel regression was used to determine whether the SR significantly influenced firm value by analyzing the results of the multiple regression models, which were summarized and tabulated. To control the unobserved heterogeneity in the data, problems relating to the estimation of fixed and random effects were incorporated. A recent study conducted by Pantzalis and Park (2014) noted that previous researchers had struggled to find good instrumental variables as a potential solution to the endogeneity problem; therefore, in their study they suggested fixed effects panel regression. From this it is clear that the key advantage of the fixed effects model (FEM) is in controlling the possible effects of unobservable variables by using dummies, in the case of panel data analysis. As a result, both the FEM and random effects model (REM) are used to test the formulated hypothesis regarding corporate SR and firm value. At the same time, the Hausman test was employed to select the appropriate specification between FEM and REM. The specification tests concluded that FEM was the best method to interpret the association between sustainability disclosure and firm value. Thus, the R^2 value apparent in Table 2 under the FEM is 19.54 percent. As depicted in the table 2, the coefficient of SR shows a positive and statistically significant effect on Tobin's Q, under the FEM ($p < 0.01$). The finding was in line with the prediction, and so hypothesis was accepted. Where control variables are concerned, both FSZ and LEV negatively influenced firm value at the level of 0.001, whereas ROE and SG had positive influence on firm value at the level of 0.01 and 0.1 respectively.

Discussion

The current findings go hand in hand with the literature (Cheung et al., 2010; De Villiers & Marques, 2016; Jo & Harjoto, 2011; Kuzey & Uyar, 2017; Lo & Sheu, 2007; Yu & Zhao, 2015), thereby providing ample evidence of a significantly positive association between corporate SR and firm value. Furthermore, the findings of this study support the value-enhancing theory, which proposes that a firm's involvement with SR adds a value to that firm. When a firm engages in socially commendable behavior, the perception of society about the firm would be much more favorable and consequently the firm is likely to be rewarded with a premium value in the capital markets.

In other words, the ethical reputation of a firm could be regarded as an intangible asset that shapes the market price of the firm's shares while rewarding the investors in the capital markets. This is because, a sustainable investor will keen interest to aggregate his/her judgments and transmit them to the firm, either as a financial reward or as a punishment. All in all, these results reveal that the firms disclosing sustainability information enjoy higher firm value, and this has prompted the Sri Lankan listed firms to deem disclosure of sustainability information as a value relevant practice. Curiously though, the present finding was contradictory with the finding of Cristomo et al. (2011), who reported a significant negative impact of CSR on firm value. The findings reported in relation to the control variable are also compatible with the findings of Kuzey and Uyar (2017), Lo and Sheu (2007) and Yu and Zhao (2015). According to Lo and Sheu (2007), the negative effect of LEV on firm value signals that there may be an active external control from debt holders (creditors) who monitor the corporate managers. Except for the effect of FSZ, the effects of the other three variables on SR were compatible with the findings of Jo and Harjoto (2011).

Limitations and Implications

As is common with many other studies, particularly those conducted in emerging and developing markets is that the results should be considered with caution. This is because the measure of SR variable represents only whether the particular firm discloses sustainability information or not, without providing an adequate insight into the quality of the reporting. Thus, the results reported in this study may not suffice to confirm the causality. However, this measurement issue is not a specific issue encountered by just this study. In fact, it is a common issue faced by many other international researchers as well. Moreover, the scope of the current study was limited only to the listed companies in Sri Lanka. This limits the generalizability of the study results to all companies (non-listed companies) in the country.

As for the implications of this study, the researchers believe that the knowledge gained from the findings will be useful to many parties including capital market participants, managers, regulators, social and environmental activists and academics. The capital market participants will use sustainability information to make their investment decisions while managers may use it to communicate their ethical behavior as exemplary citizens. Regulators can use sustainability in-

formation to ensure the integrity of managers' behavior, and if necessary they can consider enforcing the regulations to neutralize managers' self-interested behavior. Social and environmental activists can disseminate their views among the business community and convince them of the importance of engaging in environmentally and socially responsible activities by encouraging more disclosures. The academics too can make use of the findings of this study to broaden their contribution towards corporate disclosure literature.

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THE ASSESSMENT OF CONTRACTORS' AWARENESS ON SUPPLY CHAIN COLLABORATION: A CASE STUDY

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Abstract

The purpose of this study is to assess the level at which contractors are aware of supply chain collaboration and takes into understanding their relationships. This takes into cognizance their relationship with their supplier and subcontractors. This was in order to recommend a structure that will enhance improvement in construction project management. An empirical exploration was carried out through a case study with a questionnaire design based on literature review. The case reports on the challenges observed from projects for the government of Botswana. The intentions were to present a collective analysis of the construction supply chain. The analysis reveals that awareness of supply chain collaboration by contractors studied in is low. However, the study expresses the sincerity to integrate a collaboration agreement in construction projects to improve awareness. It only needs the will to vary some of the contract terms and add regulations to make it suitable.

Key Words: Supplier relation management; project management; supply chain collaboration; construction industry.

Introduction

There are growing contractual requirements and demands within the construction sector, therefore it has to persistently bend to acquire competitive challenges. Therefore to achieve short-term business objectives which have a long-term competitive advantage, one needs to improve "construction supply chain collaboration" (CSCC) to enhance performance, (Eriksson 2010). Throughout the planning and design stage, the most critical resolutions concerning the outcome of a complete facility are supposed to be made before commencing with construction. However participants of chains in construction projects are continuously challenged to supply projects successful because of various reasons, one of them being how they collaborate.

Poor communication which happens during planning leads to poor performance and directly impacts the customer by increasing project schedule and cost of the project, (Behera, Mohanty, and Prakash 2015). There is a dire need to decrease roots to significant wasted time and delayed decisions. Suitable communication procedures need to be created to avoid communication burden, (Segerstedt et al. 2010). Therefore an exploration of collaborative opportunities is needed as a strength to model inter-organizational innovation in construction, (Behera, Mohanty, and Prakash 2015). To direct the study, the creation of mutual decisions, sharing information, and sharing benefits, by chain members, (Simat-upang and Sridharan 2002) was adopted as the definition for construction supply chain collaboration.

Aims and Objectives of the Study

The aim of this research was to advocate out a collaboration structure for supply chains in construction projects which will emphasize growth. This will extend best practices to resolve the problems of supply chain collaboration found in construction projects. The objectives of the study were to conduct an empirical investigation to establish the level of supply chain collaboration awareness within construction projects using a case study in Botswana (particularly contractors). This was done to feature ways to inspire and energies construction project management's rapid growth in supply chain management. In addition to that, to motivate the establishment of reciprocated decisions.

Gaps and Contributions

Explanation of the major gaps that have been recognized after the review of the literature is that there is still inadequate literature stimulating supply chain collaboration in construction projects. Literature reveals how firms interact and link together in the construction supply chain but it does not show a clear way of matching the decision-making style in a strategic method that will indicate a collaboration relationship drive. Most of the literature is focused towards supply chains dealing with manufacturing, this makes the construction industry battle to organize their growth in supply chain philosophies. The existing contexts do not address supply chain collaboration in contract management, where the building owner has some sort of a privity of relationship with suppliers as members of the chain and illustrate a relationship between parties that is accepted to

be arbitrated by law. Hence a gap that exists in supply chain collaboration practices for the construction industry, particularly in the construction projects scenario acquired through the traditional procurement. Apart from finding the gaps, this manuscript makes suggestions to improve contract team relationships that will improve sharing information and benefits. This was done after studying and reporting the relationship levels of implementation of construction supply chain collaboration.

This study makes a contribution to knowledge in the form of a recommendation for a collaborative bidding which will finally improve procuring entity-supplier relations within government projects. Therefore the important key contribution is the suggestions on altering relationships to suit supply chain in construction projects. This will help projects to progress towards values that are associated with global development mechanisms towards strong supply chains.

Theoretical Foundation

Supply chain collaboration is found in various environments and emphasis is being brought to the built environment to use the suitable connotation. However, the term collaboration appears to have altered meaning in the construction industry over time, (Hughes, Williams, and Ren 2012). Construction Supply Chain Collaboration (CSCC) "is the process of strategic management of data flow, undertakings, and processes, involving several links of firms and linkages involved in the provision of quality construction products and services in an efficient manner", (Akintoye, McIntosh, and Fitzgerald 2000). There are three types of supply chains that have been linked with construction projects; they are temporary ones, framework- specific and lastly company strategic types which are also considered as permanent types, (Pala et al. 2014). The management of supply chain needs properly specifying the contributing participants and their roles, however, when classifying sellers in the built environment, it depends on the side of offer zone. Hence sellers can be contractors, subcontractors, vendors, the service providers (e.g. consultants), or suppliers of building materials.

For this study, the procuring entity for the project will sometimes be referred to as the buyer or a client. The sellers will be all the bidding firms who bid as main contractors. However, sellers will also include suppliers and subcontractors as part of the agreed. It will be a benefit if the members of the chain are able to have a critical input at the planning levels for effectiveness. This makes managing supply chains effectively in the construction perspective a challenging task, (Ying, Tookey, and Roberti 2015). Attention has not been towards nourishing interactions for future business dealings except the blame culture between parties which wears away trust, (Akintan and Morledge 2013). The "importance of relationships in construction supply chains is considered essential for delivering the projects", (Sariola and Martinsuo 2015) and this makes collaboration more relevant in project management. Though supply chain collaboration may not be an only assurance for accomplishing the project on schedule, a transparent performance assessment between their subcontrac-

tors and their suppliers needs to be improved. It is one of the important features that can significantly increase productivity, (Fulford and Standing 2014). In addition to that, a vital role in improving supply chain profitability that can be benefited by all the chain members can be obtained, (Prakash et al. 2016).

However, suppliers and subcontractors are left out during design and planning of some project activities even though they will be the ones to implement, (Sariola and Martinsuo 2015). Stronger relationships would increase a sense of obligation and accountability which will, in turn, improve the project outcomes, (Fulford and Standing 2014). The relationship amongst the different parties of a multi-organisational project is reliant on the interests of the parties, (Sariola and Martinsuo 2015). However, without it, they will only be in relationships because of purchasing and trading relations which will not assist in achieving progress. Although power has influences in the importance of supply chain members, (Touboulic, Chicksand, and Walker 2014) but it can create resistance from collaborating parties.

This can defeat the notion of the creation of sharing information and benefits. However in construction traditional contracts, the contract is mainly between employer and main contractor and lacks formal synchronization disposition towards other tiers like suppliers and subcontractors, hence this study advocate for a formal link between them. The employer-contractor and contractor-supplier relationships point out that if suppliers and employer are not in any contractual relationship with each other, the relationship is expected to be weak", (Sariola and Martinsuo 2015). Positive preceding connections have a substantial effect on the growth of reliance at the beginning of the project, (Buvik and Rolfsen 2015). However "instances of attraction or repulsion will happen when values, norms, and attitudes differ", (Love, Irani, and Edwards 2004), but if members of a supply chain are closely connected their relationship will improve, (Nath and Standing 2010). Although collaboration may seem tricky to the construction industry, suppliers engage in collaboration on multiple levels of analysis, (Müller and Martinsuo 2015).

Therefore to learn from these multiple levels, inter-organizational collaboration, cooperation and learning between contractors and their suppliers will be enriched, (Wickramatillake et al. 2007).They can even make use of building an automated communications program to strengthen a relationship-centric standpoint to create sharing information which will enhance the creation of mutual decisions. The client needs to assist contractors to take their focus off the price in order to build a "future price" Hence the industry needs collaboration which is related to the exchange of information, in structured collaboration setups. For the achievement of a building project, one of the necessities is the capability of the main contractor to choose the suitable subcontractor, (Yoke-Lian et al. 2012). When dealing with multiple team participants, to allocate decision supremacy amongst them is a thought-provoking concern, (Cui 2016), but it is still imperative to increase process innovation, (Un and Asakawa 2015).

To boost an organization's competitive advantage, combining the resources that exist elsewhere may be necessary, (Jia and Lamming 2013). In addition to that a contractor, who sticks to the same trading subcontractors on many projects, is not only building an enhanced relationship with his trading partners into a cohesive supply chain but also producing an investment, (Khalfan and Maqsood 2012). An understanding of supplier bidding performance will help to procure entities design healthier sourcing directions in this procurement regime, and this will improve procurement performance, (Shao 2017). It will be challenging for suppliers to support interests or a financial responsibility when one organization has information that other members are not privy too, (Narayanan and Raman 2004).

Hence this study proposed to bring out a structure which portrays the role of a relationship-centric perspective where the intention is to sustain an operational and strategic "commitment with suppliers as a crucial way to manage construction supply chains", (Pala et al. 2014). Managing construction supply chains is challenging the construction industry because of their intricate structure, they also work in a project-based short-term mode, and hence temporary supply chains seem easy for them. However strategic relationships are worth investing in, though they require some additional investment in time and communication which often require custom-made dealings, (Fulford and Standing 2014). The entire construction chain has to comprehend the requirements and change their systems and operations to fit into stringent procedures to attain a perfect outcome, (Wickramatillake et al. 2007).

The construction industry needs to understand collaboration and its relevance in contractual relations. A need for contractual plans to include complementary contracts with appropriate practices, (Poppo and Zhou 2014), is important. The collaboration will help to co-create services with both partners and customers in business (Fjeldstad et al. 2012) and produce tactical relationships, (Dietrich et al. 2010). Materials supply subcontracting have a substantial and direct bearing on time, cost, and quality. Therefore the client, main contractors, sub-contractors, and suppliers must be willing to reveal profound business documents. This structure will be in line with a noble communication which will be the basis for building a long-term relationship with reliable suppliers, (Zuo et al. 2009). This means clients, contractors, building owners and suppliers have to be prepared to share part of sensitive information. Toyota decided to procure an engine from a competitor by using BMW, they even extended to do collaborative marketing together, (Bhalerao 2013). This made them reveal some of the acute details for the collaboration to work. If this small integration is considered, then a change for the supplier necessities have to be given a slot in the contract. Successful operation depends on all partners involved, therefore, issues like risk need to be co-governed, if along the way they seem a bit out of an individual partner's control, (but in a collaborative and coordinated way), (Karlsson, Asenova, and Valkama 2012).

Awarding Incentives

To lessen some of the project risks during collaboration, incentives may have to be granted to cover for opportunity costs. Incentive-based contracting have been seldom implemented to correct construction project performance, (Love, Irani, and Edwards 2004). Relationship-based procurement structures and their inducement arrangements are many occasions focused exclusively on the contracts between clients, consultants and main contractors", (Sariola and Martinsuo 2015), but neglect suppliers and subcontractors. However, the creation of incentives that encourages partners to act in a way that maximises the supply chain's profits and changing contracts might be necessary to compensate for acting in the team's paramount interests, (Narayanan and Raman 2004).

Methodology

The research methodology adopted and analysis of the data that was collected guided the conclusions and recommendations. All these were based on the gaps identified and the intentions to contribute to knowledge. This study explored the supply chain collaboration with a strong point on the characteristic of collaboration within construction projects, with emphasis on the creation of mutual decisions. This was in regard to building an improved contract management. Since it has been reflected in an exploratory research on supply chain collaboration, the study was done in a quest for estimations on how contractors collaborate to assess their awareness. With so many collaborative strategies with value creation, a few basic theoretical principles which can suit supply chain in construction were selected. An empirical study was conducted in a cross-sectional time horizon and sources of data were logged from a case study.

The case was selected from one of Botswana's government ministries which amongst its portfolio responsibilities is the delivery of basic infrastructure. The case selection picked Botswana since it is a developing country and therefore needs a critical eye. This was to check if the awareness on construction supply chain collaboration is also developing in line with the global improvements. The case study strategy was also selected because it will provide in-depth insights to understand fully the dynamics of the case, (Saunders 2011). Preliminary informal interviews were conducted with some project managers and suppliers to assess the nature of the relationship and to provide insight into formulating the questionnaire. This was conducted on the basis of the literature reviewed to accumulate specifics which provided some guidance in the design of the questionnaire. Before circulating the questionnaires, they were piloted to some contractors randomly to assess responsiveness. The corrected questionnaire consisted of two pages which were divided into 2 main sections but in total had 5 subsections. The questionnaire with a cover letter was dispersed to 82 companies undertaking the projects and this was through hand delivery and emails. A database availed from a technical department which indicated the number of contractors and their contact details was used for questionnaire circulation. The selected subjects had to have the willingness to contribute to the study and pro-

vide the needed access to the researcher.

Out of the 82 questionnaires distributed, 57 responses were received. However, at least 46 responses were received as acceptable while 11 were rejected. The results of a survey are considered biased if the return rate is lower than the range of 30 and 40%, (Moser and Kalton 1971). Though this is a case study, the questionnaire response was based on the principles of a survey strategy. A response rate of 56% was achieved hence regarded as an acceptable response. When analyzing the case, great emphasis was done in agreement with the research permit issued.

Results and Analysis

A descriptive analysis was used based on questionnaires which had Likert scales and the respondents were required to rate each question. The questionnaire responses were analyzed quantitatively using Statistical Package for Social Sciences (SPSS) software. The analysis also indicates the cross tabulation frequency results. This was analyzed according to their companies' financial ceilings which are determined by Public Procurement Asset and Disposal Board of Botswana. Items in the main part of the questionnaire were coded into strongly agree, agree, neutral and disagree and strongly disagree, with a Likert scale of 5, 4, 3, 2, 1 respectively. However, they were recoded into agree, neutral and disagree, but with a scale of 3, 2, 1 respectively to reduce ranges of the prevailing values, (Saunders 2011). Cronbach's alpha values were measured for internal consistency between a set of items as a group or scale reliability and were accepted if above 0.70 but unacceptable if below 0.5, (Nunnally 1967).

The statistical concepts used in this type of analysis was the frequency distribution, which was acquired by the ranking of the variables, through the data entry. In addition to that, for comparing the means, a sample t-test was used to check if a sample mean is significantly different from an assumed mean which was fixed at 95%. A lower mean value (below the neutral position) for section A and B indicates that majority of the respondents have rated it as low or have not agreed and shows that assertion is lacking. The null and alternative hypothesis was set out as H0: $\mu \leq 2$ and H1: $\mu > 2$. This 2 stands for the neutral position on the Likert scale. When $p<0.05$ and the t-value is positive, then the null hypothesis was rejected and the alternative hypothesis was supported, (Cohen 1992). Then a conclusion would be the respondents have not agreed or have rated it as low and these would indicate a shortfall in the concepts of supply chain collaboration. Moreover, a One-Way ANOVA test was carried out and in the course of this test, the equivalent variance was not assumed if the Levene's test for equality of variance failed.

There was no rejection of the assumption of homogeneity variance if α was more than 0.05 and this means the variances have equal significance. The dependent variables were tested across the PPADB categories factor. This was done to determine where possible the use of actions recognized in the different categories. If α was less than 0.05, then the Post Hoc test was conducted using "Student Newman Keuls" (S-N-K) test was carried out. It was done to detect sample means that were signifi-

cantly different from one another. The characteristics of the sample as shown in Table 1 indicates that out of all the responses, 63% were directors of these companies. The composition of responses was from contractors of Category OC, A, B, and C only with Category OC making almost half of the responses. Furthermore, Table 1, indicates the response for project arrangements, where contractors were asked when they do involve their subcontractors and suppliers, for projects preparations.

It has been noted that the approach towards the two differs. The frequency analysis results indicate that they involve suppliers at the time of bidding and do so for subcontractors after award. Generally, the results show that majority of the respondents from all categories do not involve both the suppliers and subcontractors if it is not a bidding period. Furthermore, the respondents indicated that they based their selection of subcontractors and suppliers on price. The location factor and past relationship factor were not really the main influences, hence accepting that price is the main dominating factor. Some of the questions were tested for reliability of the scale using the Cronbach's alpha as indicated in the text. All the alpha values ranged between 0.723 and 0.724 and this indicated that internal consistency for the scales was attained because all of them were more than 0.7.

A one-sample t-test was carried in Table 2 and across all variables, the means were below the neutral value. The respondents rated the existence of trust between their firms and their suppliers and subcontractors as low. However, it should be noted that the trust towards suppliers is far much better than the one towards subcontractors. Respondents rated the level of commitment between their firms and their subcontractors and suppliers as low. Respondents rated the level of the knowledge for their suppliers' and subcontractor's as low, and even lower for suppliers. The least rated amongst these variables is the cost transparency for both suppliers and subcontractors.

A one-sample t-test was also carried and the results displayed in Table 3 are the respondents' ratings of the relationship dealings towards their subcontractors and suppliers. There is an indication that respondents operate without a supply chain collaboration strategy in place. Then respondents were tested on whether a transparent performance assessment between their subcontractors and their suppliers do exist, with results communicated to their chain partners. The low rating indicates that majority of the respondents rated it as low and which shows that they do agree that they do not conduct the transparent assessment with their suppliers and subcontractors. Furthermore, this is supported by the lower mean results for communication to suppliers and subcontractors. If it was higher a concern would be how the performance is done if an assessment process document is not available. Most of the respondents admitted that there is a joint knowledge creation between their companies and subcontractors because the mean is slightly higher than the neutral value. Results further show that the mean difference for joint decision-making is low. Furthermore, the majority of the respondents were not willing to share their benefits with their supply chain partners, nor allow their suppliers to

Table 1. Classification Using financial ceilings and frequency response

Category		Grade OC	Grade A	Grade B	Grade C		
Government Ceilings - BWP (,000)		1,500	3,000	7,200	12,000	Freq.	%
Position of the respondent	Director	12	9	4	4	29	63.0
	Manager	2	1	4	1	8	17.4
	Other	7	2	0	0	9	19.6
	Total	21	12	8	5	46	100.0
Experience	1-10	20	9	2	2	33	71.7
	11-20	1	3	5	2	11	23.9
	>20	0	0	1	1	2	4.3
	Total	21	12	8	5	46	100
Project arrangements-suppliers	Before Bidding	2	4	2	3	11	23.9
	During Bidding	7	8	6	2	23	50
	After Award	12	0	0	0	12	26.1
	Total	21	12	8	5	46	100
Project arrangements- subcontractors	Before Bidding	3	4	2	3	12	26.1
	During Bidding	5	6	0	1	12	26.1
	After Award	13	2	6	1	22	47.8
	Total	21	12	8	5	46	100
Relationships with subcontractors	Price	21	10	1	1	33	71.8
	Location	0	1	1	0	2	4.3
	Past Relation	0	1	6	4	11	23.9
	Total	21	12	8	5	46	100
Relationships with suppliers	Price	21	10	4	2	37	80.5
	Location	0	1	2	0	3	6.5
	Past Relation	0	1	2	3	6	12.0
	Total	21	12	8	5	46	13

Table 2. One-Sample t-Test for Observation towards chain members

Rank	Items	t	df	Sig. (2-tailed)	Mean Difference	95% Confidence Interval	
						Lower	Upper
1	Commitment with suppliers	15.693	45	.000	1.43478	1.2506	1.6189
2	Trust with suppliers	16.140	45	.000	1.34783	1.1796	1.5160
3	Knowledge for your subcontractors	17.390	45	.000	1.34783	1.1917	1.5039
4	Commitment with subcontractors	19.799	45	.000	1.21739	1.0935	1.3412
5	Trust with subcontractors	20.218	45	.000	1.19565	1.0765	1.3148
6	Knowledge for your suppliers	17.897	45	.000	1.19565	1.0611	1.3302
7	Cost transparency with subcontractors	28.941	45	.000	1.06522	.9911	1.1394
8	Cost transparency with suppliers	47.000	45	.000	1.02174	.9780	1.0655

Table 3. One-Sample t-Test- relationship

No	Items	t	df	Sig. (2-tailed)	Mean Difference	95% Confidence Interval	
						Lower	Upper
1	SCC strategy in place	14.513	45	.000	1.54348	1.3293	1.7577
2	Transparent performance assessment suppliers	13.801	45	.000	1.73913	1.4853	1.9929
3	Results communicated to suppliers	19.174	45	.000	1.54348	1.3813	1.7056
4	Transparent performance assessment for subcontractors	13.400	45	.000	1.73913	1.4777	2.0005
5	Results communicated to subcontractors	16.368	45	.000	1.39130	1.2201	1.5625
6	Joint knowledge creation with subcontractors	13.721	45	.000	2.04348	1.7435	2.3434
7	Suppliers Joint decision making	17.321	45	.000	1.30435	1.1527	1.4560
8	Sub-contractors Joint decision making	14.648	45	.000	1.69565	1.4625	1.9288
9	Willing to share its risks	13.721	45	.000	2.04348	1.7435	2.3434
10	Willing to share its benefits	16.930	45	.000	2.06522	1.8195	2.3109
11	Main contract to allow SCC clause	18.610	45	.000	2.30435	2.0549	2.5537

When testing overall awareness level of supply chain collaboration, a cross-tabulation analysis was made between the categories. About 81% of the Category OC indicated that their awareness was low. Furthermore, 58.3% of Category A rated it as low as well as 75% from Category B. Around 80% of the Category C contractors also indicated a low awareness level. When bundling all these respondents, about 73.9% of them indicated that their awareness level is low. However, there is an acceptance that the main contract has to include a clause that allows formal supply chain collaboration. There was a statistical significance in the perceptions identified for all the categories falling within this section as shown in Table 4. However, they were all assessed with a Student-Newman-Keuls (S-N-K) for Post Hoc results and all did not reject the assumption of homogeneity variance since they were all

more than 0.05. Results indicated that contractors have very low knowledge about their subcontractors and their supplier's' businesses for all categories. However, for Category C, they displayed a medium knowledge towards their supplies business probably because of experience in the industry. Engaging each other before bidding will contribute to knowledge creation in projects and knowledge for either their suppliers' or subcontractor's business even beyond project closure. There is also an indication that commitment towards both subcontractors and suppliers is generally low even though it was better at Category C. In addition to that, trust levels are low, this will contribute to difficulty in information sharing, more especially where tenders are involved.

The results in Table 5 indicate, that there is no statistical significance in the differences identified between the categories, with the exclusion of results communicated to suppliers and joint knowledge creation with subcontractors. The two were then assessed with a Student-Newman-Keuls (S-N-K) for Post Hoc results. We did not reject the assumption of homogeneity variance since their "α" was more than 0.05 and this means the variances have equal significance. Discussions
The results have indicated that these contractors do not have strategies that guide on how they collaborate nor clearly show mutual decisions on their dealings. These point to the fact that the relationships are only anchored on informal relationships and have no clear and articulate collaboration strategy.

The results show that there is a need to form a collaborative supply chain. This can be designed to react swiftly where suppliers, subcontractors, and the contractors are used jointly to plan. If chain members can agree to some disclosures of key information e.g. payments to their clients (employers), then concerns of availability of right materials at right time for the right activity in a budget-constrained contractors. This validates the insight of low collaboration levels between the contractors and their suppliers and subcontractors. The visions of attaining accurate collaboration in this approach will take longer to be accomplished if the price will always determine the relationship, and it will confirm the study of Holaday (2013) that it is rare to experience true collaboration. Furthermore, early involvement of keychain members (like suppliers and subcontractors) in bidding is essential, though the majority of the respondents indicated they involve them at a later stage. The results from respondents indicated knowledge of contractors' suppliers' and subcontractors' as low which goes against the note by Kamakshisundaram (2014) that it is important for contractors to know their suppliers' suppliers to manage risks and it will help to choose to proactively predict risk rather than anticipating it. Therefore the knowledge of contractors' suppliers' and subcontractors' businesses is essential to supply chain collaboration.

Table 4. Degree of Doing Business

Rank	Items Cronbach's Alpha: 0.723	Cat. OC	Cat. A	Cat. B	Cat. C	Total	Anova sig.**
1	Trust with suppliers	1.2381	1.1667	1.5000	2.0000	1.3478	.021
2	Trust with subcontractors	1.1905	1.0000	1.1250	1.8000	1.1957	.001
3	Commitment with suppliers	1.3333	1.4167	1.2500	2.2000	1.4348	.025
4	Commitment with subcontractors	1.1905	1.0833	1.1250	1.8000	1.2174	.006
5	Knowledge for your suppliers	1.0476	1.2500	1.0000	2.0000	1.1957	.000
6	Knowledge for your subcontractors	1.0952	1.4167	1.3750	2.2000	1.3478	.000
7	Cost transparency with suppliers	1.0000	1.0000	1.0000	1.2000	1.0217	.036
8	Cost transparency with subcontractors	1.0000	1.0000	1.0000	1.6000	1.0652	.000

Notes: **statistical significance of the comparison between means of categories of contractors registered with PPABD

Table 5. Degree of Collaboration

	Items Cronbach's Alpha: 0.724	Cat. OC	Cat. A	Cat. B	Cat. C	Total	Anova sig.**
1	SCC strategy in place	1.4286	1.7500	1.6250	1.4000	1.5435	.626
2	Transparent performance assessment suppliers	1.5714	1.8333	2.0000	1.8000	1.7391	.646
3	Results communicated to suppliers	1.4286	1.8333	1.2500	1.8000	1.5435	.046
4	Transparent performance assessment subcontractors	1.5714	2.0000	1.7500	1.8000	1.7391	.620
5	Results communicated to subcontractors	1.2381	1.5833	1.3750	1.6000	1.3913	.332
6	Joint knowledge creation with subcontractors	1.6667	2.3333	2.0000	3.0000	2.0435	.032
7	Disclosure of key information	1.0000	1.0000	1.0000	1.0000	1.0000	
8	Suppliers Joint decision making	1.3810	1.2500	1.3750	1.0000	1.3043	.482
9	Sub-contractors joint decision making	1.3333	2.0833	1.7500	2.2000	1.6957	.018
10	Willing to share its risks	1.8571	2.3333	1.7500	2.6000	2.0435	.278
11	Willing to share its benefits	2.0476	2.2500	2.0000	1.8000	2.0652	.772
12	Awareness of SCC	1.1905	1.4167	1.2500	1.2000	1.2609	.565

Notes: **statistical significance of the comparison between means of categories of contractors registered with PPABD

situation will be certain, (Dixit, Srivastava, and Chaudhuri 2013). There is a demonstration that price is the main factor for choosing suppliers and sub-

Close and formal collaboration amongst the firms will be one of the strategic drivers that support SCM, (Ying, Tookey, and Roberti 2015), to create mutual decisions and sharing benefits. Since results for the level of commitment between their firms and their in control to complete the task on time if supplier relationship management is operated collaboratively. The important key contribution is the style to modify contract relations to accommodate suppliers in government contracts which will in turn increase responsiveness towards construction supply chains. The conclusion for the entire results backed by the last item in Table 5, is that awareness of proper supply chain collaboration is low. As evidenced by empirical data, there is no formal connection between main contractor and suppliers. Categorically, companies undertaking these projects do work together but in a random manner which needs to be value-added. Moreover, for awareness to propagate, concerns for decisions, risk sharing and it's distribution principle which can balance and reward the parties involved have to be seriously considered. Comprehensive principles of collaboration are to be established early in a project and this will make constructive information for decision making be availed at the beginning. It is important to know what makes collaborations unsuccessful or thrive, (Vereecke and Muylle 2006); (Walker et al. 2013). The precarious query will be how one will notice a deceitful collaboration to avoid issues of corruption. However directives and rewards to foster them must be put in place to guide, and monitoring will be necessary, (Fulford and Standing 2014).

The government needs to be fascinated by the significance of supply chain relationships shaped at the end of each project. The worst consequence might be when the stronger alliance is more important than the benefits intended for the project. Nevertheless, for the main con-

subcontractors and suppliers, it is necessary to implem

tractor, they still have an obligation to focus on the construction activities on the site and having to achieve the constraints of cost, time and quality. Just like nominated subcontractors, suppliers have to be vetted for diverse competencies, including quality, and reliability. To intensify it to support awareness, vetting for diverse competencies such as financial sustainability, quality, past relationships has to be used to reduce price being the main factor for choosing supply chain members. These can be implemented in a sealed-bid to induce competition between the suppliers just as it is done with sub-con-tractors, and this will govern the rules of delivery and reduce politics. Otherwise, it will be in line with the study of, (Walker et al. 2013), that conflicting urgencies and politics will affect adopting new trends that can assist in collaboration. This will support a high level of commitment, trust and information sharing will be required to make it more advanced than coordination as pointed out by the study of (Soosay and Hyland 2015). A collaboration arrangement which includes issues of bidding, forecasting, risks allocation and tasks to collaborate on, has to be formed and be part of the main contract. This will also include the type of information to share which can lead to joint decisions. Procuring entities can use it to share information intensively but in a selective method agreed in the

collaboration contract. Awarding for good performance, incentives and lessons learned and training can be made part of this collaboration structure to encourage supply chain collaboration. If incentives are agreed, then it will be necessary to conduct incentive audits which will help limit issues of corruption and also aid in improvement programs. The firms who keenly exhibit the effect of this focus through the entire process can be measured by the customer and used as a point of reference. This will further encourage a strategic contracting for firms who have more than one project to form a multi-project relationship which can be labelled as a Collaboration Relationship Drive (CRD). Therefore contracts need to be revised to include these new trends that aid fruitful collaboration. Nevertheless, in a network of small and medium-sized contractors, there is a need to have a dominant player who will take the responsibility to coordinate the collaboration even though it will increase risks associated with it. Otherwise approaching collaboration in a haphazard method will conceal the strength or the level at which supply chains in construction projects are progressing. They need to collaborate in a focused method within the supply chain family in construction projects to prove awareness.

Contribution to Knowledge

This study contributes to knowledge by increasing the attentiveness in the value of supply chain relationships produced during projects than making savings where formal relationships have not been built. Therefore it is vital to integrate a collaboration structure in construction contracts. Then implement by linking the main contracting parties in a construction project to the other tiers of the supply chain through a formal agreement. This will make members display upgrading attitude into awareness of supply chain collaboration through a collaboration relationship drive. It only needs the will to vary some of the contract terms and add regulations to make it suitable. The most important objective is to form a convention between the main contracting parties and the second tier firms and produce a collaboration relationship motivation. Since the empirical evidence has shown that supply chain collaboration is low within some of the construction companies studied, the contribution to the industry is that it is needed to increase the level of contractual flexibility needed for a project to be successful. This will build up a collaborative planning and manage construction supply chains beginning with small contractors and this will prevent errors, rather than late detection. The drive will hoist interventions to facilitate joint decision-making in construction supply chain and encourage supply chain collaboration awareness growth. It will also limit issues of lack of ownership in issues of time and cost overruns. It will also profit proper partnering solutions in construction projects. Although this study makes an important input to the supply chain collaboration literature and implications in the industry of construction, it has more limitations that open up for future research. The small sample size limits the opportunity for generalization because of the overall population. Therefore the results must be interpreted

with precautions, more so that a cross-sectional research methodology was adopted. Another recommendation is that future studies may collect data from other construction projects but in a survey method within the same country or across countries to compare.

Conclusions

The construction supply chains are demonstrated mainly to the coordination and integration of undertakings between the main contractor and the employer but mostly leave out other important chain members. Tolerance of some contractual relationship which extends beyond the main contract has to be accommodated. However, the main client has to properly assess the agreement for suitability with the main contract and if there are any variations that may be seen detrimental to the main contract, be modified. The level of contractual flexibility will motivate the choice of collaboration needed for awareness to improve. If prepared earnestly, positive outcomes of reducing time delays will be achieved. This will display good supply chain collaboration and make sharing benefits easy.

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