ISSN (Print): 2077-7973
ISSN (Online): 2077-8767
DOI: 10.6977/IJoSI.202212_7(4)

International Journal of Systematic Innovation

VOL. 07 NO.04
December, 2022

Published by the Society of Systematic Innovation

Opportunity Identification & Problem Solving

ISSN (Print): 2077-7973
ISSN (Online): 2077-8767
DOI: 10.6977/IJoSI.202212_7(4)

The International Journal of Systematic Innovation

Publisher:

The Society of Systematic Innovation

Editorial Office:

- The International Journal of Systematic Innovation
- 6F, # 352, Sec. 2, Guanfu Rd, Hsinchu, Taiwan, R.O.C., 30071
- e-mail:editor@systematic-innovation.org
- web site: http://www.IJoSI.org

ISSN (Print): 2077-7973
ISSN (Online): 2077-8767
DOI: 10.6977/IJoSI.202212_7(4)

INTERNATIONAL JOURNAL OF SYSTEMATIC INNOVATION

CONTENTS

December 2022 VOLUME 7 ISSUE 4

FULL PAPERS

DOI: 10.6977/IJoSI.202212_7(4).0001
A. Waqas, H. Halim, N. Ahmad / Int. J. Systematic Innovation, 7(4), 1-17(2022)

Design leadership and SMEs Sustainability; Role of Frugal Innovation and Technology Turbulence

A. Waqas[1], H. Halim[2], N. Ahmad[2]
[1] PhD Scholar, School of Management, University Sains Malaysia, Penang, Malaysia
[2] Professor, School of Management, University Sains Malaysia, Penang, Malaysia
Corresponding author E-mail: ali.90waqas@gmail.com
(Received 16 March 2022; Final version received 17 September 2022; Accepted 28 September 2022)

Abstract

Climate change and poverty are among the emerging issues of economies around the globe. To resolve these issues, United Nations have introduced the SDGs and enforced organizations to adopt business practices that are less harmful to society. Even international organizations couldn't implement sustainability practices at a large scale and this situation is more vulnerable in the context of SMEs. Therefore, SMEs' outcomes i.e. financial, social, and environmental performance are compromised (Álvarez Jaramillo, Zartha Sossa, & Orozco Mendoza, 2019; Dey et al., 2020). Thus, this study aims to analyze the relationship between design leadership and SME sustainability through the mediating role of frugal innovation. Further, this study has also investigated the moderation of technology turbulence in the relationship between design leadership and frugal innovation. The quantitative survey was gathered through purposive sampling from 383 employees of SMEs working in the Lahore and Sialkot region with the help of SMEDA (Small and Medium Enterprise Development Authority). The data analysis was performed through SMART PLS 3. The result of this study reveals that there exists a positive significant relationship between design leadership and sustainability. Further, frugal innovation significantly mediates the relationship between design leadership and sustainability. Likewise, technology turbulence significantly moderates the relationship between design leadership and frugal innovation. This study also presents the implication and limitations along with the recommendation in a later section.

Key Words: Design Leadership, Frugal Innovation, Sustainability, Technology turbulence.

1. Introduction

The enormous damage to the climate in recent years and poverty have become major challenges for economies around the world. The growing interest of the people in climate change has caused pressure on the stakeholders of manufacturing firms to adopt pro-environmental practices (Shehzad, Zhang, Le, Jamil, & Cao, 2022). Additionally, the recent COVID-19 outbreak was a great shock and affected more than 200 countries (Worldometer, 2022). As the virus was contagious and restrictions were implemented on several businesses and other gatherings (Papadopoulos, Baltas, & Balta, 2020). These worldwide restrictions have severely affected SMEs as compared to large-scale firms. This enormous damage can be understood through the economical suffering of SMEs in several countries i.e. 41% of SMEs business in the UK(Juergensen, Guimón, & Narula, 2020), 50% of SMEs in Germany (DIHK, 2020), 70% of the SMEs in Italy (OECD, 2020), and 27% in China (Dai et al., 2021) were affected by COVID-19. While considering these emerging issues all over the world, sustainable goals provided by United Nations have gained more familiarity (Iqbal, Ahmad, Li, & Li, 2021; Smith, Discetti, Bellucci, & Acuti, 2022; Ullah, Ahmad, Rehman, & Fawad, 2021). Further, sustainability consists of three key elements i.e., economic, social, and environmental (Dima et al., 2022; Frobisher, 2021) which are helpful to mitigate emerging challenges of climate change, poverty, and other uncertain situations. Similarly, it is noted that sustainability becomes the reason for ecological and financial well-being (Dos Santos, Lampreia, & Ahmad, 2020). These benefits of sustainability encourage the organization to opt for the sustainability measures in their systems, however, SMEs are facing the enormous challenge of sustainability adoption

(Das, Rangarajan, & Dutta, 2020) because of lower resources and capabilities as compared to multinational companies(Papadopoulos et al., 2020). Previously, it is also noted that SMEs in developing countries are lacking in their focus on social and environmental issues due to inadequate support from the organization and poor implementation of the laws (Das et al., 2020).

On the contrary, SMEs' sustainability is crucial for the economic well-being of economies all over the world because it contributes majorly to the business of several economies i.e. 99.3% of the private businesses in the UK (Business, 2014), 99.8% of all the enterprises in Europe (Commission, 2019; Južnik Rotar, Kontošić Pamić, & Bojnec, 2019) and 60% of the industrial growth in China (Huang, Boateng, & Newman, 2016) is based on the SMEs. Similarly, SMEs have a major contribution to the economy of developing countries as they provide 33% of national income and 45% of total employment (iQualify, 2015; Yoshino & Taghizadeh-Hesary, 2018).

Besides this, emerging markets have gained attention internationally, as currently 17% of the revenue of multinational companies is based on emerging markets and it has a potential of US$ 30 trillion by 2025 (Ernst, Kahle, Dubiel, Prabhu, & Subramaniam, 2015). Emerging markets are comprised of two types of customers i.e., high income and low income. These emerging markets demand cost-effective products and value at lower prices which is possible through frugal innovation (Pisoni, Michelini, & Martignoni, 2018). These customers at bottom of the pyramid demand less innovative but compatible products (Cai, Ying, Liu, & Wu, 2019). Thus, frugal innovation tries to meet the needs of bottom-line customers with limited resources (Pansera & Sarkar, 2016). Precisely, resource-limitation of emerging firms encourages unique ways to innovate fundamentally which meet the requirements of the cost-sensitive customers of the emerging markets (Cai et al., 2019; Martin, Romero, & Wegner, 2019). However, a unique and innovative process is possible through design leadership which considers the future and undertakes the innovative design in the manufacturing process (Muenjohn & McMurray, 2017). For the successful adoption of innovation in organizational processes, studies show that design leadership (Muenjohn & McMurray, 2017) plays an important role. Leadership can effectively utilize such strategies which enable innovation in the overall processes of SMEs(Iqbal, Ahmad, & Halim, 2021). Therefore, design leadership can contribute to the innovation process, however, empirical evidence regarding how design leadership transforms the innovative process into sustainability is not well focused (Muenjohn & McMurray, 2017). Though, collaborative innovation and its outcomes were analyzed previously, however, it is necessary to understand the factors which contribute to the innovation process and lead the SMEs sustainable outcomes (Torfing, Cristofoli, Gloor, Meijer, & Trivellato, 2020).

Furthermore, changing nature of today's competitive environment introduces several uncertainties to businesses as the technologies obsolete rapidly and introduce challenges to organizations. The higher uncertainties in the business environment cause challenges for SMEs (Zhang, Lettice, & Pawar, 2019). Similarly, it is noted that technological turbulence influences innovation processes (Yun, Lee, & Lee, 2019). However, SMEs are not capable to innovate in such a rapidly changing environment (Zhang et al., 2019). Therefore, it is necessary to empirically understand how technological turbulence can influence SMEs' innovation process.

Previously, it is noted that organizations are striving for innovative business processes to ensure sustainability (Shibin, Dubey, Gunasekaran, Luo, Papadopoulos, Roubaud, et al., 2018). Literature has also considered the innovation capabilities and strategies of emerging market firms but lacks a comprehensive understanding of context (resource-constrained economies) based on innovative processes and their key indicators(Audretsch, Seitz, & Rouch, 2018; Cai et al., 2019; Tiwari, Kalogerakis, & Herstatt, 2016). Further, literature has considered the role of bricolage and sustainable leadership with frugal innovation (Iqbal, Ahmad, & Halim, 2021), however, technology turbulence in today's rapidly changing environment may influence the SMEs' frugal innovation process and ultimately compromise the sustainability. It is already noted that the impact of technological turbulence on ecological sustainability was overlooked (Chen, Li, Chen, & Ou, 2018). Previously, the role of external environmental factors i.e., technological turbulence was ignored among the relationships of key resource utilization strategies, design leadership, and frugal innovation. It is also noted that the relationship between leadership and strategic processes of sustainability should be empirically investigated in different contexts to bring a conclusive outcome from this relationship (Eide, Saether, & Aspelund, 2020). Furthermore, literature has documented frugal innovation in terms of products, services, processes, and characteristics (Annala, Sarin,

& Green, 2018), and marketing strategies for such products(Rosca, Arnold, & Bendul, 2017), however, strategic decisions and mechanism to pursue, and antecedents of frugal innovation were ignored (Ploeg, Knoben, Vermeulen, & van Beers, 2021). Besides this, studies have considered the strategies, and innovation processes of multinational companies, however, SMEs were ignored(Papadopoulos et al., 2020). Thus, this study investigates the role of key strategies toward the sustainability of SMEs through the mediated moderation of technological turbulence. This study will be helpful for the developing countries to overcome the sustainability issue of SMEs. Further, this study will be helpful to understand the design leadership as the key factor to produce the frugal products which might help the SMEs of developing countries to sustain in the market. It will also be helpful to understand how the external elements like technology turbulence can affect the innovation processes of the SMEs of developing countries. Beside this, it provides the empirical evidence regarding the key contributing factors of frugal innovation and its relationship with sustainability in the presence of the key hindrance factor from the external environment.

2. Literature Review

2.1. Underpinning theories

The present study framework is underpinned by the theory of Resource Base View and Contingency theory as supporting theory. RBV theory emphasizes that firms can attain a competitive advantage over their competitors through distinct resource utilization strategies (Andrews, 1971). RBV stresses that firms can utilize the bundle of resources either tangible or intangible (Barney, 1986) to attain a competitive advantage. Organizational design, environmental awareness, and technology are the key resources of any organization and they can influence sustainability(Shibin, Dubey, Gunasekaran, Luo, Papadopoulos, Roubaud, et al., 2018). Therefore, RBV theory provides us the base on which an organization can utilize its scarce resources in such a way that can help to produce more innovative products. It is noted that the customer-oriented innovative products enable the organization to achieve sustainability in the market(Shibin, Dubey, Gunasekaran, Luo, Papadopoulos, Roubaud, et al., 2018). SMEs lack the resources; design leadership can help in attaining innovatively designed products according to the need of customers. SMEs can utilize design leadership to achieve frugal products to serve their lower-income customers which will be helpful to attain business sustainability.

Furthermore, the Contingency theory explains the oscillations in business performance caused by the interaction of the firm with the environment (Lawrence, 1967; Rosenzweig, 1979). This theory stresses that firms operate in an open environment and their processes and their decisions should be environment fit (Rosenzweig, 1979). Further, organizations in the environment are exposed to various threats and it influences their profitability and innovation process (Teece, 1986). Fit between organizational strategies and its external environment can be helpful to achieve sustainable competitive advantages (Lawrence, 1967). The uncertainty in the environment due to the changing nature of technologies exhibits challenges for the organization and negatively influences the organizational innovation process (Sheng, Zhou, & Lessassy, 2013; Zhang, Wang, Zhao, & Zhang, 2017). Thus, drawing based on contingency theory, there exist several factors in the environment which can influence the performance of SMEs i.e. government policies and regulations, political situations, power dynamics, and market trends (Gunasekaran & Spalanzani, 2012). This modern era where technology is changing rapidly makes it difficult for SMEs to compete in the market due to their limitations. Therefore, in this study, RBV and Contingency theory are used as underpinning and support theories, respectively. RBV emphasizes the organizational available resources' utilization in an innovative way to sustain the market along with the insight of Contingency theory to deal with the uncertainties that exist in the organizational environment.

2.2. Design Leadership and Frugal Innovation

The leadership role in the design functions of the organizations has been recognized (Muenjohn & McMurray, 2017). Design leadership includes foreseeing the future, and investing in designing through establishing strategies and a design environment (Muenjohn & McMurray, 2017). Muenjohn and McMurray (2017) have empirically investigated the SMEs through an online survey of SMEs in Thailand and Vietnam and noted that design leadership keeps the employees aligned to the organization's strategic design

vision and nurtures the environment that leads the innovation (Muenjohn & McMurray, 2017). Further, organizations try to be averse to risks while disruptive innovation is due to a lack of organizational capabilities. Disruptive innovation requires innovative solutions and it stresses the need for design leadership as it can be helpful to overcome the issue of disruptive innovation (Torfing et al., 2020).

Previously, studies have discussed leadership and innovation, however, the recent developments around the world require an innovative solution that emphasizes the need for design leadership to attain market-based innovation in organizations (Torfing et al., 2020). Torfing et al. (2020) have qualitatively and comparatively reviewed the literature and found that institutional design leadership is helpful in the issues of innovation. Similarly, Rosca et al. (2017) have gone through several case studies of frugal innovation and noted that frugal innovation includes product designing which provides affordable products to low-income customers. Further, product design significantly determines sustainability (Rosca et al., 2017). Therefore, the following hypothesis can be generated from the above discussion:

H1: Design Leadership has a positive and significant relationship with frugal innovation.

2.3. Frugal Innovation and Sustainability

The foundation of frugality is already established in philosophy and religious studies, however, frugality concerning innovation is a recent concept (Albert, 2019; Tiwari et al., 2016). Frugal innovation is explained as more with less which increases the value by avoiding the usage of diminishing resources (Prabhu & Jain, 2015). Further, frugal innovation encompasses two elements i.e., affordable value innovation and cost innovation (Ernst et al., 2015). Frugal innovation determines the limited resource usage to produce sustainable but affordable products while targeting lower-income customers (Albert, 2019; Hossain, Levänen, & Wierenga, 2021).

It is also noted that resource slack and the pressure of cost minimization encourage organizations to produce socially valuable products to fulfill the needs of lower-end customers (Ali, Haldar, Khan, & Ullah, 2015). Albert (2019) has done a systematic review of frugal innovation and found that frugal innovation help in reducing socio-economic inequalities and solving the critical issue of resource shortage and sustainability. It is also noted that emerging markets have attracted 20,000 international corporates and around 40% of their revenue comes from China and India (Shibin, Dubey, Gunasekaran, Luo, Papadopoulos, & Roubaud, 2018). Thus, emerging economies like China and India can adopt frugal innovation to attain sustainable growth (Khan, 2016).

Previously, Levänen et al. (2016) have investigated the literature i.e. cases, reports, and articles on frugal innovation, and found that frugal innovation has a relationship with sustainability from a social, economic, and ecological perspective. Additionally, it can influence sustainable performance (Albert, 2019; Wohlfart, Bünger, Lang-Koetz, & Wagner, 2016). Further, frugal innovation is significantly associated with the social element of sustainable development(Albert, 2019). Recently, another investigation has qualitatively analyzed the cases of frugal innovation and revealed that frugal innovation can play a role as an antecedent of sustainability (Hossain, 2020).

H2: Frugal Innovation has a significant and positive relationship with Sustainability.

2.4. Design Leadership, Frugal Innovation and Sustainability

Sustainable development goals of the United Nations have emphasized the consideration of large-scale measures regarding economic well-being, environmental protection, reduction of poverty, and improvement in social trust (Halisçelik & Soytas, 2019). Leadership has key importance towards sustainability goals as they make the plans and encourage unique strategies which are helpful to attain sustainable performance (Tsalis, Malamateniou, Koulouriotis, & Nikolaou, 2020). In such a scenario, design leadership can be helpful to adopt frugal innovation and ultimately meet the requirements of low-income customers. Pisoni et al. (2018) have done a systematic review of the key studies which have investigated frugal innovation and revealed that frugal innovation provides sustainable solutions through the efficient utilization of scarce resources. Similarly, another study has done a systematic review of the literature on frugal innovation and its role in sustainability and found that frugal processes utilize the minimum resources and becomes the reason for a firm's profitability (Khan, 2016). Through frugal innovation, quality life can be provided to lower-income customers through affordable and value-added

products (Albert, 2019). Similarly, it has been noted that frugal innovation increases the profit ratio of organizations through cost-effective products and ser

vices. Frugal innovations include the process of recycling, minimum use of resources, and waste management which ultimately increases ecological performance (Hossain, 2020). Iqbal, Ahmad, and Halim (2021) have done a systematic review of the studies on frugal innovation and noted that frugal innovation benefits economic performance as it consumes low energy and encourages resource conservation. Further, frugal innovation helps organizations to reduce the influence of organizational processes on the environment as it motivates eco-friendly activities (Iqbal, Ahmad, & Halim, 2021). On the contrary, frugal innovation cannot be adopted directly, and it requires the strategies to utilize the resource in such a way that helps in low-cost innovation processes. It is also noted that frugal innovation is a complex process and does not independently confirm sustainability (Iqbal, Ahmad, & Halim, 2021; Leliveld & Knorringa, 2018). Therefore, design leadership is taken as the antecedent of frugal innovation to attain sustainability. From the above discussion following hypothesis is developed:

H3: Frugal Innovation mediates the relationship between design leadership and Sustainability.

2.5. Moderation of Technological Turbulence

Technology turbulence can be defined as the degree to which technological change occurs in any industry (Chen et al., 2018). The rapid change in technology leads to obsolescence of technology (Wu, Liu, & Zhang, 2017). In this modern era, organizations encourage the utilization of internal resources to deal with the changing requirements of technology (Jansen, Zhang, Sobel, & Chowdury, 2009). Further, technology is changing more rapidly after the 4.0 industrial revolution as it offers several alternatives to exhibit innovative and creative processes (Wu et al., 2017). Ogbeibu, Emelifeonwu, Senadjki, Gaskin, and Kaivo-oja (2020) collected the data through a time lag survey from the manufacturing firms in Malaysia and determines that technology turbulence encourages the organizations to adopt the latest technologies and increases their employee's skills (Ogbeibu et al., 2020) and it may influence their organizational strategies and innovation processes. Further, technologies are rapidly becoming obsolete, and their new replacement is more innovative and improve product quality, and increases business market share (Pandit, Joshi, Sahay, & Gupta, 2018). Previously, the influence of technology turbulence on the organization's innovative processes and their sustainable outcomes is not documented well. Further, SMEs are not capable to deal with the rapid changes in technologies and it brings a challenge for them to meet the innovative demands and ultimately affect their sustainability. It is also noted that studies have overlooked its influence on the organization's capabilities, creativity, and innovation (Ogbeibu et al., 2020).

H4: Technological turbulence moderates the relationship between Design Leadership and Frugal Innovation.

2.6. Theoretical Framework

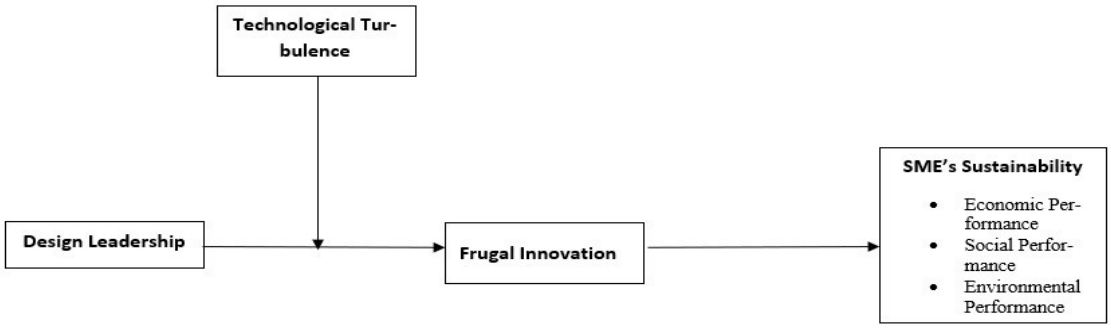

Fig. 1.

3. Methodology

3.1. Data collection and sampling

In this study, data were collected from the SMEs operating in Pakistan. Mainly, Lahore and Sialkot region and Karachi are the industrial areas of SMEs. However, due to the shortage of time and distance between Lahore and Karachi, SMEs of the Lahore and Sialkot region were selected. Previously, studies have qualitatively analyzed frugal innovation, its antecedents, and outcomes (Hossain, 2021; Levänen, Hossain, & Wierenga, 2022). Furthermore, the majority of studies have done investigations based on the literature review to understand the drivers of frugal innovation and its outcomes (Iqbal, Ahmad, & Halim, 2021; Khan, 2016; Pisoni et al., 2018). However, there is a need for practical evidence regarding the antecedents of frugal innovation and how it can transform the innovation process of SMEs into sustainability. Another study by Iqbal, Ahmad, and Halim (2020) investigated quantitatively the relationship of sustainable leadership with sustainable performance through the mediation of frugal innovation to empirically present the understating of the relationship among these constructs. Therefore, the current study is based on the survey to gather the data from the SMEs and empirically presents the evidence regarding the design leadership which can facilitate the SMEs towards frugal innovation and ultimately attain sustainability. Further, this study presents empirical evidence on how external factors like technology turbulence can influence the relationship between design leadership and frugal innovation which is not documented well previously. The major industrial portion of Pakistan is based on SMEs, likewise, SMEs significantly contribute to employment and economic development. Small and Medium Enterprises Development Authority (SMEDA) noted that SMEs contribute 90% to the overall industry of Pakistan, 80% to non-agricultural employment, and 40% to the annual GDP of Pakistan (Iqbal, Ahmad, & Halim, 2021). Additionally, frugal innovation-based products consist of the major market as the population affords low-cost products and these SMEs meet the requirements of the population with frugal innovation-based product features. We collected data from SMEs in Pakistan. These firms mainly cluster in Lahore and Karachi metropolitan industrial areas. As most SMEs are in two metropolitan cities; therefore, it serves the purpose of generalizing the findings for the country. The purposively sampling was used to collect the data from the management staff of these targeted SMEs. To measure the reasonable sample size, G*Power (3.1.9.7 version) was utilized, and the required sample size was 96. However, this study has collected data from 383, which is exceeding the required sample size. Further, this study's data is also above the minimum data requirement of PLS-SEM i.e., 100 (Reinartz, Haenlein, & Henseler, 2009).

3.2. Instruments

The variables of this study were measured through already developed and standardized scales. The questionnaire of this study was based on a 5-point Likert scale ranging from strongly disagree=1 to strongly agree=5. Further, design leadership was measured through 18 questions-based scales of Arham, Boucher, and Muenjohn (2013). The frugal innovation was measured through the 3-item scale of cost innovation and 2-items of affordable value innovation adopted from Zeschky, Winterhalter, and Gassmann (2014). Technology turbulence was measured through the 4-item scale of Jaworski and Kohli (1993). However, sustainability was measured through environmental, economic, and social performance. Environmental performance and economic performance were measured through 6-items and 5-items scale respectively adopted from Zhu and Sarkis (2004). Finally, social performance was measured through the 5-item scale of Sayce and Ellison (2003).

4. Findings

4.1. Data Analysis and Results

Smart PLS 3 was used to apply the PLS-SEM for data analysis as it is a recent estimation technique(Ali, Rasoolimanesh, Sarstedt, Ringle, & Ryu, 2018; Ringle, Da Silva, Bido, & Ringle, 2015). The relationship among this study variables is also explained with the

support of the theory and PLS-SEM is a useful approach to predict

these relationships (Hair Jr, Hult, Ringle, & Sarstedt, 2016; Ringle, Wende, & Will, 2005). Further, a two-stage approach of analysis was utilized to analyze the measurement model and structural model (Anderson & Gerbing, 1988). Additionally, bootstrapping was also done in PLS-SEM to check the path coefficient and significant levels.

4.2. Data normality

PLE-SEM does not require data normality, however, inferential statistics stresses the importance of checking the data normality before further analysis. Data normality is not required in PLS-SEM, even though it has key importance to be checked before the inferential statistics (Hair, Money, Samouel, & Page, 2007). However, to achieve the accuracy and to bring more convincing results, we have checked the data normality through SPSS 21, and the skewness and kurtosis were normally distributed between -2 to +2 which confirms the data normality.

4.3. Common method bias

Data was gathered single time from respondents separately and can become the reason for common method bias. So, a multi-collinearity test can be applied to check the problem of common method bias (Kock, 2015). Thus, collinearity was analyzed through VIF which assesses the common method bias. This study constructs have a VIF value lower than 3.3 which shows that this study constructs have not the issue of common method bias (Kock, 2015).

4.4. Demographics

Table 1 reveals the demographic details of the current study participants. The sample size of this study was 383 and table 1 shows the results that 322 (84.1%) were male and 61 (15.9%) were female. Further, of 383 participants, 185 (58.3%) were single and 198 (51.7%) were married. As well as age is concerned, 123(32.1%) of the participants were from 18-25 years, 195 (50.9%) were from 25-35 years and 63 (16.4%) were from 35-50years and 2 (0.5%) were above 50 years. Further, 95 (24.8%) of this study's participants have done bachelor's, 227(59.3%) of the participants have done master and 61(15.9%) of the participants have other qualifications. Lastly, results in table 1 show that 97 (25.3%) of the participants have experience of less than one year, 218 (56.9%) have experience of 1-5 years, 37 (9.7%) have experience of 6-10 years and only 31 (8.1%) have experience of above 10 years.

Table 1.

Demographic Variables	Category	Frequency	Percentage
Gender	Male	322	84.1%
	Female	61	15.9%
Marital Status	Single	185	48.3%
	Married	198	51.7%
Age	18-25	123	32.1%
	25-35	195	50.9%
	35-50	63	16.4%
	Above 50	2	0.5%
Education	Bachelors	95	24.8%
	Master	227	59.3%
	Others	61	15.9%
Experience	Less than 1 year	97	25.3%
	1-5 year	218	56.9%
	6-10 year	37	9.7%
	Above 10 years	31	8.1%

4.5. Measurement model assessment:

Table 2 reveals the result of convergent validity which was assessed through the loadings of items, composite reliability, and AVE (Average variance extract). Factor loading of items was majorly above 0.60 and those which were beyond the standard limit (10 items of design leadership; DL2,DL3,DL5,DL6,DL7,DL9,DL10,DL13,DL16 and DL18) were excluded because of lower loadings from the standard value. Likewise, all the constructs have shown composite reliability above 0.70 which meets the standard criteria (Ali et al., 2018). Additionally, all of this study constructs have AVE above the standard value of 0.50 (Fornell & Larcker, 1981; Hair Jr et al., 2016). However, the AVE of design leadership was 0.471 which is close to 0.5, it is acceptable to 0.4 according to the previous study and if CR is above 0.6 even then the convergent validity is fulfilled (Fornell & Larcker, 1981).

Table 2.

Constructs	Items	Loading	rho-A	Alpha	CR	AVE
Design Leadership	DL1	0.691	0.844	0.84	0.876	0.471
	DL11	0.653				
	DL12	0.713				
	DL14	0.734				
	DL15	0.683				
	DL17	0.629				
	DL4	0.76				
	DL8	0.612				
Economic Performance	Eco P1	0.943	0.869	0.777	0.853	0.553
	Eco P2	0.525				
	Eco P3	0.598				
	Eco P4	0.599				
	Eco P5	0.939				
Environmental Performance	Env P1	0.761	0.844	0.841	0.883	0.56
	Env P2	0.656				
	Env P3	0.768				
	Env P4	0.853				
	Env P5	0.713				
	Env P6	0.722				
Frugal Innovation	FI1	0.832	0.847	0.848	0.892	0.622
	FI2	0.798				
	FI3	0.738				
	FI4	0.822				
	FI5	0.75				
Social Performance	Soc P1	0.895	0.931	0.924	0.943	0.767
	Soc P2	0.907				
	Soc P3	0.87				
	Soc P4	0.847				
	Soc P5	0.858				
Technology Turbulence	TT1	0.885	0.855	0.854	0.911	0.774
	TT2	0.873				
	TT4	0.882				

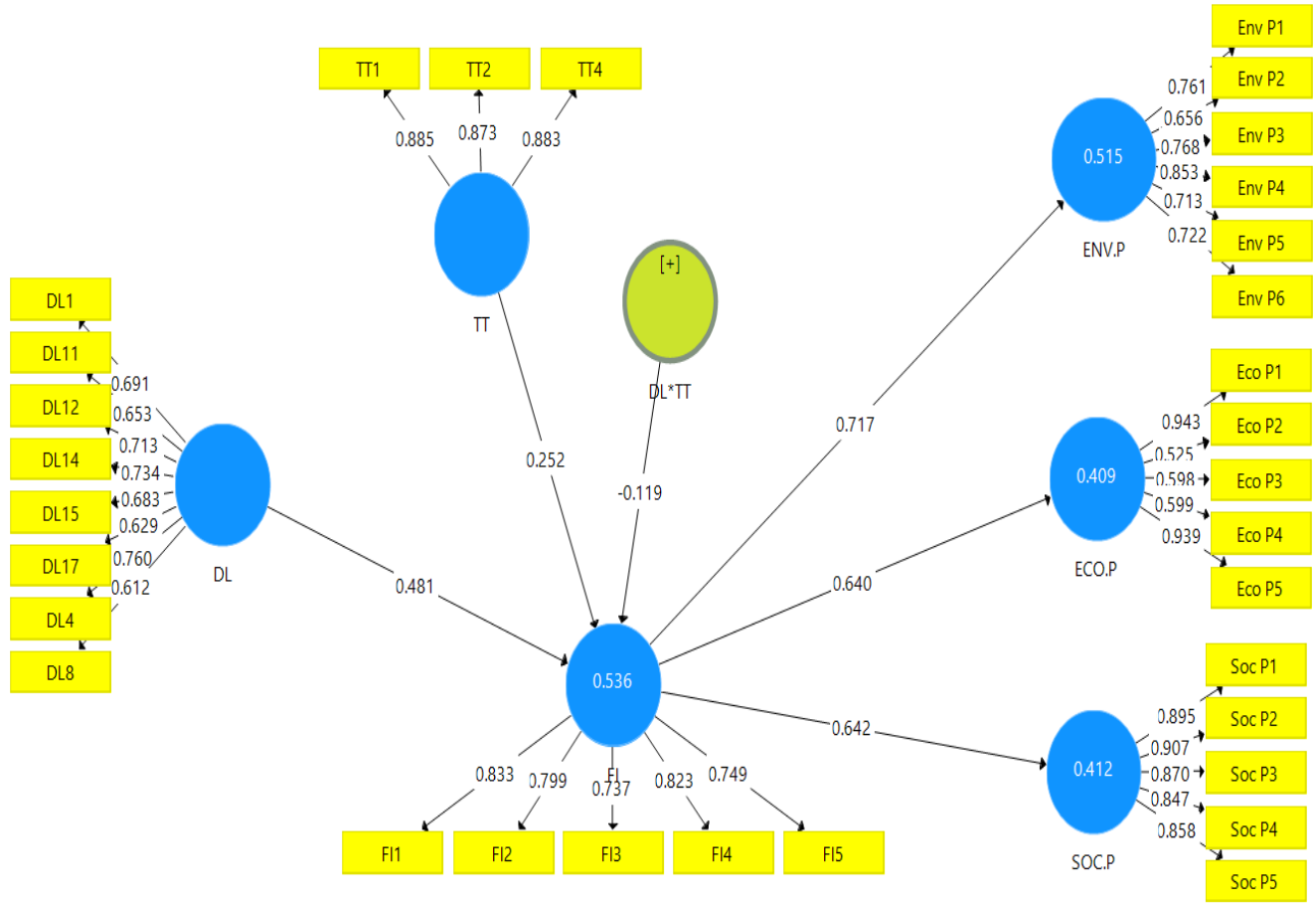

Fig. 2 Measurement Model Assessment

4.6. Discriminant validity

HTMT and Fornell-Larcker are both criteria to assess the discriminant validity of constructs, however, Fornell-Larcker cannot identify the discriminant validity effectively in a few situations (Henseler, Ringle, & Sarstedt, 2015). Thus, HTMT ratio was checked to analyze the discriminant validity of this study constructs. The results in table 3 show that HTMT value of this study's constructs is lower than the threshold value of 0.90 (Hair Jr, Sarstedt, Ringle, & Gudergan, 2017), so it fulfills the criteria of discriminant validity.

Discriminant Validity

Table 3.

	DL	ECO.P	ENV.P	FI	SOC.P	TT
DL						
ECO.P	0.656					
ENV.P	0.764	0.549				
FI	0.776	0.746	0.838			
SOC.P	0.732	0.514	0.635	0.716		
TT	0.721	0.454	0.851	0.708	0.603	

Structural model assessment The structural model was also analyzed through bootstrapping at SMART PLS (Ringle et al., 2005). Therefore, the relationship between this study variables was investigated through path coefficients, standard errors, and t-values. Moreover, the relationships between this study constructs were also tested through empirical hypothesis which can be seen in table 4. That all of this study's hypotheses were accepted according to the standard of $P< 0.05$ and $t>1.645$ (95% confidence interval).

Table 4. Path Analysis

Relationships	Beta	SD	T-value	P-value	Decision
DL -> FI	0.469	0.045	10.506	0	Supported
FI -> Eco P	0.641	0.036	17.838	0	Supported
FI -> Env P	0.717	0.034	21.044	0	Supported
FI -> Soc P	0.642	0.036	17.66	0	Supported
TT -> FI	0.311	0.046	6.832	0	Supported
DL -> FI -> Eco P	0.301	0.035	8.56	0	Supported
TT -> FI -> Eco P	0.199	0.028	7.041	0	Supported
DL -> FI -> Env P	0.337	0.034	9.905	0	Supported
TT -> FI -> Env P	0.223	0.038	5.861	0	Supported
DL -> FI -> Soc P	0.301	0.037	8.08	0	Supported
TT -> FI -> Soc P	0.2	0.032	6.234	0	Supported
DL*TT -> FI	-0.128	0.025	5.169	0	Supported

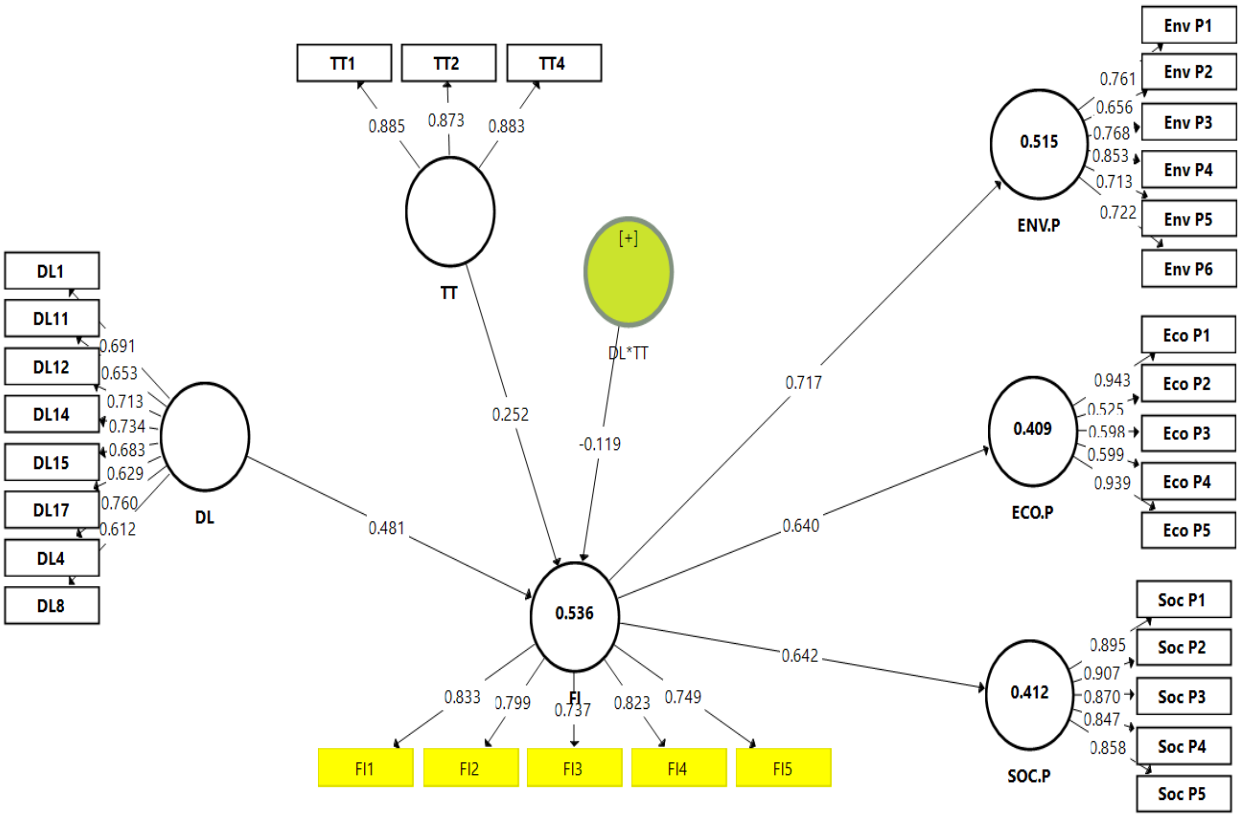

Fig. 3. Structural Model Assessment

Discussion

Recently, organizations are striving for sustainability in their operations because of rising issues of environmental and climate change around the globe. Therefore, SMEs are looking for processes that meet the requirements of people and cause less damage to society and its environment. This requires innovative processes which create cost-effective solutions (Cai et al., 2019). Thus, this study aims to investigate the relationship between design leadership and SMEs' sustainability through the mediating role of frugal innovation. Further, this study has also investigated the moderating role of technology turbulence in the relationship be-

tween design leadership and frugal innovation. Previous studies lack empirical investigation of how design leadership can transform the innovation process into sustainability. This study has considered the SMEs of Pakistan and collected data from the employees of SMEs. However, lower-level labor was excluded as the SMEs in Pakistan have both kinds of employees i.e., educated, and uneducated. While considering education as the nominal level to understand the questionnaire and industry, only educated employees and their supervisors were included while distributing the survey.

The result of this study shows that design leadership significantly and positively influences sustainability. Previous studies have not empirically tested the relationship between design leadership and sustainability in the context of SMEs. However, these results are in line with the findings of previous studies in which a positive and significant relationship between design leadership and organizational innovation was revealed (Muenjohn & McMurray, 2017). furthermore, there is not any empirical investigation that has considered the relationship between design leadership with frugal innovation and SMEs sustainability. However, these results are concurrent with the finding of the previous studies in which other leadership styles were found positive and significant with organizational innovation i.e. sustainable leadership and frugal innovation (Iqbal et al., 2020), transformational leadership and innovation (Lei, Gui, & Le, 2021) and self-leadership and innovation (Marvel & Patel, 2017). Similarly, this study's results reveal that frugal innovation significantly and positively influences sustainability. This finding is also according to the results of previous studies (El-Kassar & Singh, 2019; Iqbal, Ahmad, Li, et al., 2021; Mat Dahan & Yusof, 2020). This study has also analyzed the moderating role of technological turbulence between the relationship of design leadership and frugal innovation. The results show that technology turbulence significantly moderates the relationship between design leadership and frugal innovation. Previously, the empirical testing of this relationship is missing. However, these findings are in line with the finding of previous

turbulence in the relationship between design leadership and frugal innovation as compared to the previous study (Iqbal, Ahmad, & Halim, 2021) which tested the moderating role of bricolage between sustainable leadership and frugal innovation. Methodologically, this study has measured frugal innovation through two sub-variables i.e. cost innovation and affordable value innovation as compared to the previous studies (Iqbal, Ahmad, & Halim, 2021). Previously, studies that market uncertainty and technological changes can influence the organization's innovation process i.e., frugal innovation (Iqbal, Ahmad, & Li, 2021; Rosca, Agarwal, & Brem, 2020).

5.1. Conclusion

This study aims to analyze the relationship between design leadership and SMEs sustainability through the mediation of frugal innovation. Further, the moderation of technology turbulence between the relationship of design leadership and frugal innovation was also tested. The results of this study reveal that design leadership has a positive and significant relationship with SMEs' sustainability. Furthermore, frugal innovation significantly mediates the relationship between design leadership and SMEs' sustainability. Similarly, technology turbulence also significantly but antagonistically moderates the relationship between design leadership and frugal innovation.

5.2. Theoretical Implications

This study has contributed to the literature regarding the relationship between design leadership and sustainability. This study is among the initial studies which have empirically tested the relationship between design leadership and sustainability. Further, this study has enhanced the literature on the resource-based view (RBV) and contingency theory while investigating the mediation of frugal innovation between the relationship of design leadership and sustainability through the moderation of technology turbulence. This study has analyzed the relationship between design leadership and sustainability through the mediation of frugal innovation as compared to the previous study (Iqbal, Ahmad, Li, et al., 2021) which investigated the mediation of frugal innovation between sustainable leadership and environmental performance. Further, this study has investigated the moderating role of technology

studies (Hossain, 2021; Levänen et al., 2022) have qualitatively undergone the antecedents of frugal innovation and its outcomes (Hossain, 2021; Levänen et al., 2022), however, this study provides empirical evidence among the key indicators of frugal innovation and sustainability as an outcome.

5.3. Practical Implications

From the angle of the practical scenario of SMEs, this study has several implications for SMEs administration, managers, and policy developers. Further, this study provides empirical evidence in light of RBV regarding how the management of SMEs can utilize design leadership to transform the innovation processes into the desired outcomes. Additionally, manufacturing firms are under great pressure to control their operations and business activities to reduce the negative effect on the environment and carbon footprints through minimum resource utilization and other renewable resources(Iqbal, Ahmad, & Halim, 2021). Thus, this study will enable the management of SMEs to utilize design leadership to innovate frugally and ultimately attain sustainability. In the same manner, this study will be helpful for SMEs to understand how technology turbulence can affect the frugal innovation process and prepare them to reduce its impact. Therefore, managers of Small and medium enterprises should focus on design leadership to produce cost-innovative and affordable value-innovative products to meet the low-end customers of emerging markets. This will not only retain their business but also the overall sustainability. Furthermore, the innovation processes of the manufacturing firms may be influenced by technological changes and SME management should be prepared to cope with these external uncertainties by enhancing their skills or innovatively designed production capability.

5.4. Limitations and Future directions

This study has a few shortcomings as well. This study provides empirical evidence regarding the relationship between design leadership and sustainability only from Pakistan's SMEs. Therefore, future studies should also consider the different countries to improve the generalizability. Further, this study has taken single-time data and a longitudinal survey can create a better understanding of how the design leadership and innovation strategies can be sustainable as an outcome. Future studies should consider the managerial level and CEOs and board members of the SMEs as they better understand the external environment and uncertainties. In this study, cultural context is not considered which may influence the relationship between design leadership and frugal innovation. As Pakistan is based on collectivism, it can moderate the relationship between leadership and innovation. Furthermore, future studies can also investigate the mediation of subdimensions of (cost innovation and affordable value innovation) of frugal innovation. Likewise, political pressure i.e. dysfunctional competition in developing countries can also affect the innovation process of SMEs. On the contrary, SMEs are based on the initiatives of very few people and usually have a single owner. Therefore, individual behavioral factors i.e., frugality as an individual trait can exhibit a significant effect on the organizational innovation process. Therefore, further studies should consider the frugal behaviors of SMEs' leadership as the antecedent of sustainability.

References

Albert, M. (2019). Sustainable frugal innovation-The connection between frugal innovation and sustainability. Journal of Cleaner Production, 237, 117747.

Álvarez Jaramillo, J., Zartha Sossa, J. W., & Orozco Mendoza, G. L. (2019). Barriers to sustainability for small and medium enterprises in the framework of sustainable development—L iterature review. Business Strategy the Environment 28(4), 512-524.

Anderson, J. C. & Gerbing, D. W. (1988). Structural equation modeling in practice: A review and recommended two-step approach. Psychological bulletin, 103(3), 411.

Andrews, K. R. (1971). Concept of corporate strategy.

Annala, L., Sarin, A., & Green, J. (2018). Co-production of frugal innovation: Case of low cost reverse osmosis water filters in India. Journal of Cleaner Production, 171, S110-S118.

Business, F. o. S. (2014). Small business statistics. Retrieved from http://www.fsb.org.uk/stats

Cai, Q., Ying, Y., Liu, Y., & Wu, W. (2019). Innovating with Limited Resources: The Antecedents and Consequences of Frugal Innovation. Sustainability, 11(20), 5789.

Chen, T., Li, F., Chen, X.-P., & Ou, Z. (2018). Innovate or die: How should knowledge-worker teams respond to technological turbulence? Organizational Behavior Human Decision Processes, 149, 1-16.

Arham, A., Boucher, C., & Muenjohn, N. (2013). Leadership and entrepreneurial success: A study of SMEs in Malaysia. World Journal of Social Sciences, 3(5), 117-130.

Audretsch, D. B., Seitz, N., & Rouch, K. M. (2018). Tolerance and innovation: the role of institutional and social trust. Eurasian Business Review 8(1), 71-92.

Barney, J. B. (1986). Organizational culture: can it be a source of sustained competitive advantage? Academy of management review, 11(3), 656-665.

Commission, E. (2019). Annual report on European SMEs 2018/2019 Research and Development and Innovation by SMEs, Luxembourg. Retrieved from https://op.europa.eu/en/publication-detail/-/publication/cadb8188-35b4-11ea-ba6e-01aa75ed71a1/language-en

Dey, P. K., Malesios, C., De, D., Budhwar, P., Chowdhury, S., & Cheffi, W. (2020). Circular economy to enhance sustainability of small and medium-sized enterprises. Business Sdtrategy the Environment, 29(6), 2145-2169.

DIHK. (2020). Auswirkungen des Corona-Virus auf die deutsche Wirtschaft: DIHK-Blitzumfrage März 2020, Deutsche Industrie- und Handelskammern. Berlin: DIHK.

Dima, A., Bugheanu, A. -M., Dinulescu, R., Potcovaru, A. -M., Stefanescu, C. A., & Marin, I. (2022). Exploring the Research Regarding Frugal Innovation and Business Sustainability through Bibliometric Analysis. Sustainability, 14(3), 1326.

Dos Santos, Lampreia, M. J. P., & Ahmad, N. (2020). Sustainability of European agricultural holdings. Journal of the Saudi Society of Agricultural Sciences, 19(5), 358-364.

El-Kassar, A. -N., & Singh, S. K. (2019). Green innovation and organizational performance: the influence of big data and the moderating role of management commitment and HR practices. Technological Forecasting Social Change, 144, 483-498.

Ernst, H., Kahle, H. N., Dubiel, A., Prabhu, J., & Subramaniam, M. (2015). The antecedents and consequences of affordable value innovations for emerging markets. Journal of Product Innovation Management, 32(1), 65-79.

Fornell, C., & Larcker, D. F. (1981). Structural equation models with unobservable variables and measurement error: Algebra and statistics. In: Sage Publications Sage CA: Los Angeles, CA.

Frobisher, P. (2021). A Strategic Model of Innovation. International Journal of Systematic Innovation, 6(3), 19-29.

Gunasekaran, A., & Spalanzani, A. (2012). Sustainability of manufacturing and services: Investigations for research and applications. International journal of production economics, 140(1), 35-47.

Hair, J. F., Money, A. H., Samouel, P., & Page, M. J. E. T. (2007). Research methods for business.

Hair Jr, J. F., Hult, G. T. M., Ringle, C., & Sarstedt, M. (2016). A primer on partial least squares structural equation modeling (PLS-SEM): Sage publications.

Hair Jr, J. F., Sarstedt, M., Ringle, C. M., & Gudergan, S. P. (2017). Advanced issues in partial least squares structural equation modeling: saGe publications.

Halisçelik, E., & Soytas, M. A. (2019). Sustainable development from millennium 2015 to Sustainable Development Goals 2030. Sustainable Development, 27(4), 545-572.

Henseler, J., Ringle, C. M., & Sarstedt, M. (2015). A new criterion for assessing discriminant validity in variance-based structural equation modeling. Journal of the academy of marketing science, 43(1), 115-135.

Hossain, M. (2020). Frugal innovation: Conception, development, diffusion, and outcome. Journal of Cleaner Production, 262, 121456.

Hossain, M. (2021). Frugal innovation and sustainable business models. Technology in Society, 64, 101508.

Hossain, M., Levänen, J., & Wierenga, M. (2021). Pursuing frugal innovation for sustainability at the grassroots level. Management Organization Review, 17(2), 374-381.

Huang, W., Boateng, A., & Newman, A. (2016). Capital structure of Chinese listed SMEs: an agency theory perspective. Small Business Economics, 47(2), 535-550.

Iqbal, Q., Ahmad, N. H., & Halim, H. A. (2020). How does sustainable leadership influence sustainable performance? Empirical evidence from selected ASEAN countries. Sage Open, 10(4), 2158244020969394.

Iqbal, Q., Ahmad, N. H., & Halim, H. A. (2021). Insights on entrepreneurial bricolage and frugal innovation for sustainable performance. 4(3), 237-245.

Iqbal, Q., Ahmad, N. H., & Li, Z. (2021). Frugal-based innovation model for sustainable development: Technological and market turbulence. Leadership Organization Development Journal.

Iqbal, Q., Ahmad, N. H., Li, Z., & Li, Y. (2021). To walk in beauty: Sustainable leadership, frugal innovation and environmental performance. Managerial Decision Economics.

Jansen, B. J., Zhang, M., Sobel, K., & Chowdury, A. (2009). Twitter power: Tweets as electronic word of mouth. Journal of the American society for information science technology, 60(11), 2169-2188.

Jaworski, B. J., & Kohli, A. K. (1993). Market orientation: antecedents and consequences. Journal of Marketing, 57(3), 53-70.

Juergensen, J., Guimón, J., & Narula, R. (2020). European SMEs amidst the COVID-19 crisis: assessing impact and policy responses. Journal of Industrial Business Economics, 47(3), 499-510.

Južnik Rotar, L., Kontošić Pamić, R., & Bojnec, Š. (2019). Contributions of small and medium enterprises to employment in the European Union countries. Economic Research-Ekonomska Istraživanja, 32(1), 3296-3308.

Khan, R. (2016). How frugal innovation promotes social sustainability. Sustainability, 8(10), 1034.
Kock, N. (2015). Common method bias in PLS-SEM: A full collinearity assessment approach. International Journal of e-Collaboration, 11(4), 1-10.
Lawrence, P. R., & Lorsch, J. W. (1967). Organization and environment. Homewood, IL: Irwin.
Lei, H., Gui, L., & Le, P. B. (2021). Linking transformational leadership and frugal innovation: the mediating role of tacit and explicit knowledge sharing. Journal of Knowledge Management.
Leliveld, A., & Knorringa, P. (2018). Frugal innovation and development research. In: Springer.
Levänen, J., Hossain, M., Lyytinen, T., Hyvärinen, A., Numminen, S., & Halme, M. (2016). Implications of frugal innovations on sustainable development: Evaluating water and energy innovations. Sustainability, 8(1), 4.
Levänen, J., Hossain, M., & Wierenga, M. (2022). Frugal innovation in the midst of societal and operational pressures. Journal of Cleaner Production, 347, 131308.
Martin, D., Romero, I., & Wegner, D. (2019). Individual, organizational, and institutional determinants of formal and informal inter-firm cooperation in SMEs. Journal of Small Business Management, 57(4), 1698-1711.
Marvel, M. R., & Patel, P. C. (2017). Self-leadership and overcoming the time resource constraint: Accelerating innovation for new products. IEEE Transactions on Engineering Management, 65(4), 545-556.
Mat Dahan, S., & Yusof, S. r. M. (2020). Review and proposed eco-process innovation performance framework. International Journal of Sustainable Engineering, 13(2), 123-139.
Muenjohn, N., & McMurray, A. (2017). Design leadership, work values ethic and workplace innovation: an investigation of SMEs in Thailand and Vietnam. Asia Pacific Business Review, 23(2), 192-204.
OECD. (2020). Tackling coronavirus (COVID-19): Contributing to a global effort. SME policy responses. Paris: OECD.
Ogbeibu, S., Emelifeonwu, J., Senadjki, A., Gaskin, J., & Kaivo-oja, J. (2020). Technological turbulence
Sayce, S., & Ellison, L. (2003). Integrating sustainability into the appraisal of property worth: identifying appropriate indicators of sustainability. Paper presented at the AREUEA conference, August.
Shehzad, M. U., Zhang, J., Le, P. B., Jamil, K., & Cao, Z. (2022). Stimulating frugal innovation via information technology resources, knowledge sources and market turbulence: a mediation-moderation approach. European Journal of Innovation Management(ahead-of-print).
and greening of team creativity, product innovation, and human resource management: Implications for sustainability. Journal of Cleaner Production, 244, 118703.
Pandit, D., Joshi, M. P., Sahay, A., & Gupta, R. K. (2018). Disruptive innovation and dynamic capabilities in emerging economies: Evidence from the Indian automotive sector. Technological Forecasting Social Change, 129, 323-329.
Papadopoulos, T., Baltas, K. N., & Balta, M. E. (2020). The use of digital technologies by small and medium enterprises during COVID-19: Implications for theory and practice. International Journal of Information Management, 55, 102192.
Pisoni, A., Michelini, L., & Martignoni, G. (2018). Frugal approach to innovation: State of the art and future perspectives. Journal of Cleaner Production, 171, 107-126.
Ploeg, M., Knoben, J., Vermeulen, P., & van Beers, C. (2021). Rare gems or mundane practice? Resource constraints as drivers of frugal innovation. Innovation, 23(1), 93-126.
Prabhu, J., & Jain, S. (2015). Innovation and entrepreneurship in India: Understanding jugaad. Asia Pacific Journal of Management, 32(4), 843-868.
Reinartz, W., Haenlein, M., & Henseler, J. (2009). An empirical comparison of the efficacy of covariance-based and variance-based SEM. International Journal of Research in Marketing, 26(4), 332-344.
Ringle, C., Da Silva, D., Bido, D., & Ringle, C. (2015). Structural equation modeling with the SmartPLS. Brazilian Journal Of Marketing, 13(2).
Ringle, C. M., Wende, S., & Will, A. (2005). SmartPLS 2.0 (beta). In: Hamburg.
Rosca, E., Agarwal, N., & Brem, A. (2020). Women entrepreneurs as agents of change: A comparative analysis of social entrepreneurship processes in emerging markets. Technological Forecasting Social Change, 157, 120067.
Rosca, E., Arnold, M., & Bendul, J. C. (2017). Business models for sustainable innovation–an empirical analysis of frugal products and services. Journal of Cleaner Production, 162, S133-S145.
Rosenzweig, J. E. (1979). Organization & Management: A Systems and Contingency Approach: New York; Montreal: McGraw-Hill.
Sheng, S., Zhou, K. Z., & Lessassy, L. (2013). NPD speed vs. innovativeness: The contingent impact of institutional and market environments. Journal of business research, 66(11), 2355-2362.
Shibin, K., Dubey, R., Gunasekaran, A., Luo, Z., Papadopoulos, T., & Roubaud, D. (2018). Frugal innovation for supply chain sustainability in SMEs: multi-method research design. Production Planning & Control, 29(11), 908-927.

Shibin, K., Dubey, R., Gunasekaran, A., Luo, Z., Papadopoulos, T., Roubaud, D. J. P. P., & Control. (2018). Frugal innovation for supply chain sustainability in SMEs: multi-method research design. 29(11), 908-927.

Smith, H., Discetti, R., Bellucci, M., & Acuti, D. (2022). SMEs engagement with the Sustainable Development Goals: A power perspective. Journal of business research, 149, 112-122.

Teece, D. J. (1986). Profiting from technological innovation: Implications for integration, collaboration, licensing and public policy. Research policy, 15(6), 285-305.

Tiwari, R., Kalogerakis, K., & Herstatt, C. (2016). Frugal innovations in the mirror of scholarly discourse: Tracing theoretical basis and antecedents. Paper presented at the R&D Management Conference, Cambridge, UK.

Torfing, J., Cristofoli, D., Gloor, P. A., Meijer, A. J., & Trivellato, B. (2020). Taming the snake in paradise: combining institutional design and leadership to enhance collaborative innovation. Policy Society, 39(4), 592-616.

Tsalis, T. A., Malamateniou, K. E., Koulouriotis, D., & Nikolaou, I. E. (2020). New challenges for corporate sustainability reporting: United Nations' 2030 Agenda for sustainable development and the sustainable development goals. Corporate Social Responsibility Environmental Management, 27(4), 1617-1629.

Ullah, R., Ahmad, H., Rehman, F. U., & Fawad, A. (2021). Green innovation and Sustainable Development Goals in SMEs: The moderating role of government incentives. Journal of Economic Administrative Sciences.

Wohlfart, L., Bünger, M., Lang-Koetz, C., & Wagner, F. (2016). Corporate and grassroot frugal innovation: a comparison of top-down and bottom-up strategies. Technology Innovation Management Review, 6(4), 5-17.

Worldometer. (2022). Covid-19 Coronavirus Pandemic.

Wu, L., Liu, H., & Zhang, J. (2017). Bricolage effects on new-product development speed and creativity: The moderating role of technological turbulence. Journal of business research, 70, 127-135.

Yoshino, N., & Taghizadeh-Hesary, F. (2018). The role of SMEs in Asia and their difficulties in accessing finance.

Zeschky, M. B., Winterhalter, S., & Gassmann, O. (2014). From cost to frugal and reverse innovation: Mapping the field and implications for global competitiveness. Research-Technology Management, 57(4), 20-27.

Zhang, M., Lettice, F., & Pawar, K. (2019). Effects of intellectual capital and university knowledge in indigenous innovation: evidence from Indian SMEs. Production planning control, 30(10-12), 799-812.

Zhang, S., Wang, Z., Zhao, X., & Zhang, M. (2017). Effects of institutional support on innovation and performance: roles of dysfunctional competition. Industrial Management Data Systems.

Zhu, Q., & Sarkis, J. (2004). Relationships between operational practices and performance among early adopters of green supply chain management practices in Chinese manufacturing enterprises. Journal of operations management, 22(3), 265-289.

AUTHOR BIOGRAPHIES

Ali Waqas is PhD Scholar at School of Management, University Sains Malaysia. His research interest are in Entrepreneurship, Innovation, SMEs and tourism management.

Hasliza Abdul Halim is a Professor at the School of Management, University Sains Malaysia. She has been lecturing for many years on subjects such as Strategic Management, Management, Organizational Behaviour, Organizational Theory and other management subjects. She currently serves as the President of the Asian Academy of Management Society (AAM). She previously worked in corporate sectors and had been involved with various consultation programs which were related to human resource development, compensation, performance appraisal and other related matters.

Dr. Noor Hazlina Ahmad is based at the Universiti Sains Malaysia, Penang, Malaysia. She, PhD, is a Professor at the School of Management USM. She joined the university after completing her PhD at the University of Adelaide, Australia. She teaches entrepreneurship and organizational behaviour-related subjects. She also supervises PhD and MA students in the field of entrepreneurship and SMEs.
Currently, she serves as the President of the Asian Academy of Management and sits on the editorial board of the Asian Academy of Management Journal. She has served as a visiting professor and external assessor at the Management and Science University.

DOI: 10.6977/IJoSI.202212_7(4).0002
N. Joseph / Int. J. Systematic Innovation, 7(4), 18-38(2022)

Factors of a Successful Information System Value Chain in Public Sector

Nazeer Joseph
Department of Applied Information Systems, University of Johannesburg, South Africa
Corresponding author E-mail: njoseph@uj.ac.za
(Received 28 September 2022; Final version received 7 December 2022; Accepted 9 December 2022)

Abstract

With an increased focus on sound financial management, public sector organisations invest extensively in the systems that direct decision-making activities. To maintain sound financial management practices, public sector organisations rely on the information from the systems in operation for decision-making activities. Information systems (IS), like value chains (VC), aim to create value in the form of information through a series of activities. To support their decision-making activities, public sector organisations invest extensively in successful IS VCs. This paper explores and articulates the attributes and CSFs of a successful IS VC in the public sector of a developing nation. The study was undertaken as a case in a public sector organization and through 20 qualitative interviews. The research study found that successful IS VCs in public sector organisations should consist of 15 attributes and should realise the seven critical success factors confirmed by the participants in the research study. Regarding attributes, three themes emerged: infrastructure, operational, and usability. The infrastructure theme consists of the attributes, namely hardware, software, and telecommunications network. The operational theme consists of four attributes, namely data, people, process, and information. The usability theme consists of seven attributes, namely reliability, relevance, accuracy, completeness, correctness, accessibility, and timeliness. Regarding critical success factors, two themes emerged: value contributors and success measures. The value contributor theme consists of the CSFs of VC quality and overall value. The success measure theme consists of the CSFs, namely IS quality, information quality, service quality, holistic benefit, and user satisfaction. The findings were articulated into a framework that aims to facilitate the design and implementation of IS VCs. The framework is a guideline to understand the intricacies of public sector IS VCs to address perennial issues such as the lack of service delivery and financial mismanagement.

Keywords: information system; value chain; information system attributes, critical success factors; financial management; decision making

1. Introduction

Organisational innovation hinges on identifying opportunities and issues in the business model and processes. An improved business model and process drives strategic intent and allows an organisation to realise the benefits of innovation initiatives. A perennial tool enabling innovative business models and processes is technology. Technology enables improved decision-making and supports innovative strategic intent. Good decision-making is driven by quality information provided through technological solutions. As defined by Ronald Reagan, *information is the oxygen of the modern age* (Lee, 2015, p. 135). Fundamentally, organisations globally invest extensively in the systems that produce information (Purwita & Subriadi, 2019). As such, information system (ISs) actions are intended to harvest value to direct decision-making activities (Rosenblatt, 2014). However, technology implementation is different across all industries and sectors. Implementing technology in the public sector is particularly challenging, given the various socio-economic and socio-political elements at play. Moreover, the effectiveness of the public sector in developing economies is often questioned, with citizens decrying the lack of service delivery of fundamental human rights and amenities.

In developing countries, the public sector provides social services and economic functions (Fourie & Burger, 2019). In South Africa, the public sector form's part of the monetary system divided into three spheres, namely, national, local, and provincial government (Thornhill, 2011). The three spheres manage public services, infrastructure development services, and ensure sound financial management practices, to name just a few (Fourie & Poggenpoel, 2017). The provincial sphere is particularly important as it is accountable for public service, commercial administration, administration and financial management, and governance functions (South African Government, 2021b). The provincial government ensures that infrastructure investment initiatives, economic planning and development, and sound financial management and governance are achieved through departments such as the department of economic development and the provincial treasury (Gauteng Provincial Government, 2022). Consequently, for the provincial government, decision-making activities towards sound practices are dependent on information that exist across multiple data points.

The value chain (VC) lens arguably provides a holistic view of the flow of information within a public

sector IS. An IS VC comprises interrelated events, actions, and activities that operate as a circular system for the of valuable and actionable information (Rosenblatt, 2014). The IS VC actions allows for unprocessed data to be gathered, transformed, saved, secured, and shared in organisations (Valacich & Schneider, 2018). It follows that IS VCs comprises several factors that must be present to produce the output needed for decision-making activities. These factors directly influence IS VCs and comprise attributes and critical success factors (CSFs) that must be present for the systems to be perceived as successful. Deprived of any significant attributes and CSFs, the systems intended to produce value may be professed as insignificant with public sector decision-making activities being affected.

The public sector is no different and invests extensively in IS VCs for the required information needed to direct decision-making activities (Alipour et al., 2017). The factors of successful IS VCs in the public sector are essential for important managerial actions at strategic and operational financial levels. These IS VCs are significant and produce the required information that directs important financial decision-making activities across all levels. The landscape of the public sector's ISs demand all attributes and CSFs in the sector VCs to function as a unit in pursuit of its joint goals. These are the mandatory factors that serve as the minimum requirements to accept input and produce the output required successfully to direct financial decision-making activities. Multiple influencing factors have a direct effect on the successes of the IS VCs. These are the attributes and CSFs that influence the provincial government's capacity to manage data and information according to a standard that is suitable to direct financial decision-making activities (Soley & Pandya, 2003).

The existing body of knowledge on successful IS VCs is largely applicable to the private sector. The uniqueness of the public sector necessitated the need to identify the attributes and CSFs specific to the public sector and to confirm their influence on successful IS VCs for the sector. The research study sought to identify and confirm the factors that include the attributes and CSFs of successful IS VCs in the public sector. Furthermore, it is imperative to explore the developing nation perspective as the socio-economic and socio-political elements differ from developed nations thus influencing the implementation and realization of an IS VC. Specifically, the provincial level of a developing nation's public sector is underrepresented in the existing body of knowledge. This research paper aims to explore and articulate the attributes and CSFs of a successful information systems value chain in the public sector of a developing nation. The following research questions are subsequently posed:

(i) What are the attributes of a successful information systems value chain in the public sector?
(ii) What are the critical success factors of a successful information systems value chain in the public sector?

The research contribution of this paper is argued from multiple perspectives. Firstly, the research reveals the attributes and CSFs of an IS VC from a developing nation perspective and provides a new context for South African public sector research. Secondly, the ramifications of the IS VC attributes and CSFs are articulated in a framework that aims to facilitate the correct design and implementation of technological solutions. This will, in turn, drive innovation and decision-making effectiveness within the provincial government sphere. Thirdly, the framework serves as the foundation for enabling quality information delivery across the provincial, local and national public sector spheres. Professionals operating in the public can use the framework as a guideline to understand the intricacies of a public sector IS VC to address perennial issues such as the lack of service delivery and financial mismanagement. Also, academics and future research could apply the framework in other developing nation contexts and enhance the framework to be more comprehensive and robust.

2. Literature Review

The IS VCs in operation in the public sector serve as sources that informs decision-making activities (Nilsson et al., 2016). The goal of this research study is to identify, recognize and review the currently available body of knowledge concerning the factors that includes the attributes and CSFs of successful IS VCs in the public sector. Literature was identified and reviewed to identify the concluded studies for successful ISs and the VCs. The significant attributes and CSFs serve as requirements for successful IS VCs in the public sector and these were identified, recognized, revised and deliberated on. Also, the effect of the attributes and CSFs on successful IS VCs were recognized for their significance towards public services, commercial, administration, financial management and governance functions towards outcomes that are beneficial to the citizens of the republic.

2.1. The Public Sector

The public sector is a segment of the general economy of a country that consist of public services and their public entities (Parkin et al., 2012). The public sector is the segment of the economic ecosystem that is managed by the local, provincial and national spheres and its entities that might differ significantly between developed and emerging countries. For developed countries, the general definition of the public sector includes government ownership or control rather than minor functions and includes the exercise of public authority or the implementation of public policy (Gersonskaya, 2020).

For an emerging nation like South Africa, the public sector consist of governmental services and civic goods that are accessible from the three spheres of government

(Thornhill, 2011). The sector is a slice of the fiscal system segregated into the local, provincial and national spheres responsible for the management of civic services, sound financial management practices, and governance functions, to name just a few (Simeon & Murray, 2001). Each of the three sphere's responsibilities is outlined in the Constitution and serves as stewards of public resources (Cheruiyot et al., 2019).

The national government is the political authority or government that controls the nation (Christopher Thornhill, 2011). At a minimum, the national government consists of several ministries with the President of the country as the head. The national government prescribes laws, sets policies, and provides services that fall within the national competencies. The national government is divided into three branches, namely, the legislature, the executive, and the judiciary (Munzhedzi, 2016).

The local government consists of municipalities that are mandated to deliver basic services that are used daily, namely, water, sanitation, and electricity, to name just a few (Reddy, 2016). This sphere of government consists of three categories of municipalities namely, metropolitan, district, and local municipalities (Koma, 2016). The goal of the local sphere is to generate revenue through initiatives to maintain, grow and improve local infrastructure and community services (Ndevu & Muller, 2017). The local government may initiate community economic planning efforts intended to build on their official municipal plan intended to influence community growth and may prescribe land use (Meyer & Meyer, 2016).

The provincial government which is the emphasis of this research study is fixed with its structures demarcated in chapter 6 of the Constitution (South African Government, 2021b). All nine provinces have a legislature that consists of members of the provincial legislature led by a Premier. The Premier as the executive head assigns members of the executive council as the political heads for departments (South African Government, 2021c). The sphere is accountable for public service areas such as health, social development, and education, for commercial functions such as agriculture, infrastructure and roads, and for sound financial administration and governance functions which are the responsibility of departments such as the provincial treasury, human settlements, local government, and the provincial legislature, to name just a few (South African Government, 2021b).

As a result, the provincial government depends on information from the IS VCs in operation for decision-making activities. The IS VCs in operation serve as the input for the insights and information required to direct actions, promote and enforce transparency and ensure sound financial management and governance activities in respect of revenue, expenditure, assets, and liabilities (Olivier, 2016). In so doing, provincial departments and entities are required to adhere to relevant laws such as the Constitution, Public Financial Management Act, Treasury Regulations, prescripts, policies, and procedures (Ramphal, 2017). Explicitly for this research study, a case study was undertaken in a provincial government department that is responsible to oversee sound financial management and governance practices in the province.

2.2. Information System Value Chains Role Towards Sound Provincial Financial Management

Financial management is the practice of handling financial resources in a manner that allows for the organisation to be successful in its activities while complying with laws and regulations as prescribed (Khominich et al., 2016). Sound financial management refers to the various methods and strategies that public sector organisations, individuals, or businesses employ to realize planned outcomes or to accomplish anticipated financial objectives (Nuryanah & Islam, 2015). Thus, sound financial management is the effective allocation and management of financial resources and their efficient and economical spending to the ideal benefit of all stakeholders (Ramphal, 2017).

To ensure that sound financial management practices are maintained, information is required that serve as the input to direct decision-making activities. Information is transformed from raw data and facts with meaning that serves as input for key decision-making activities. For information to serve a need, public sector organisations invest significant resources that, as a unit, become an IS (Stair & Reynolds, 2018). An IS consists of several interrelated factors that, as a circular system, become responsible for the important insights and information that direct decision-making activities in organisations (Coronel & Morris, 2016). They consist of a chain of value-adding processes, technology, and people that gather, create, process, safeguard, save and dispense information to ratify management, control, and communication (Martins et al., 2019).

Similarly, presented by Michael Porter in 1985, the notion VC denotes a group of sturdily related independent actions or activities that an individual, organisation or system perform to translate input into output that hold some value to the user thereof (Jones & George, 2020). A VC is an integrated arrangement that comprises of several interconnected value adding actions that transform input into the valuable output as projected for the set organisational need (Schwalbe, 2014, 2016).

The goal of IS VCs are to support decision-making activities with facts that are grounded on historical conclusions (Valacich & Schneider, 2018). Decision-making activities are the actions taken to direct or achieve a set outcome through facts that are based on historical data (Abahmane & Binkkour, 2008). This includes actions to collect, manage, allocate and spend public resources by public sector organisations within the prescripts of the law to ensure sound financial management practices are maintained.

IS VCs for sound financial management practices support the automation and integration of public financial management processes including budget formulation, execution, accounting, and reporting as stipulated by the laws of the country (Dew & Jian Xiao, 2011). The success of any outcome is dependent on the factors allied with the matter of interest (Ross et al., 2016). The factors associated with IS VCs in this research study refer to the attributes and CSFs that must be present for the system to successfully direct decision-making activities that ensure sound financial management practices.

2.2.1. Attributes of a Successful Information System Value Chain

An attribute is a feature that is seen as the inherent characteristic or part of a system (Coronel & Morris, 2016, p. 38). This may be any condition, fact or outcome that directly influences the success of the system (Rosenblatt, 2014). Successful IS VCs for the public sector are primarily assessed according to the IS attributes, VC contributors, and the system's capacity to function as a circular model with bottom-up and top-down abilities for the information required for decision-making activities (Laudon & Laudon, 2016). As a collective, these significantly different attributes become the mandatory features that successful IS VCs in the public sector should possess. Table 1 illustrates the ISs, VC, circular IS VC, and decision-level attributes needed for successful IS VCs in the public sector. Table 1 illustrates the ISs, VC, circular IS VC, and decision-level attributes needed for successful IS VCs in the public sector.

Table 1. Attributes of a successful information system value chain

	Attributes	Description	Authors
Information System Attributes	Accessibility	The quality of being able to be reached	Cho et al. (2015)
	Completeness	The state or condition of having all the required or appropriate parts	Georgiadis (2019)
	Correctness	The quality of being free from errors	Bianchi and Trimigno (2019)
	Flexibility	The ability to be easily modifiable	Forsgren et al. (2016)
	Timeliness	The quality of being done at a favourable time	Forsgren et al. (2016)
	Relevance	The quality of being closely connected or appropriate	Bianchi and Trimigno (2019)
	Reliability	The quality of being dependable or of performing consistently well	Forsgren et al. (2016)
	Accuracy	The quality of being correct	Georgiadis (2019)
	Security	The state of being free from threats or danger	Cho et al. (2015)
Value Chain Contributors	Data	The raw facts available in an organisation	Kruse et al. (2016)
	Process	The activities required to transform something	Valacich and Schneider (2018)
	Information	The new data required for decision-making	Coronel and Morris (2016)
Circular Information System Value Chain Attributes	People	The employees within the organisation	Al-Mamary et al. (2014a)
	Hardware	Visible technology used to process data	Rosenblatt (2014)
	Telecommunications networks	The infrastructure used to connect an organisation into a single unit	Valacich and Schneider (2018); Valdar (2017)
	Software	The application used to interact with the hardware	Laudon and Laudon (2016)
	Data	The evident raw facts within the organisation	Rosenblatt (2014)

	Security	The measures employed to safeguard the system	Valacich and Schneider (2018)
Decision-making Levels of Information System Value Chain	Top-down	The ability to disseminate information from the top to the bottom of the organisation	Valacich and Schneider (2018)
	Bottom-up	The ability to disseminate information from the bottom to the top of the organisation with ease	Valacich and Schneider (2018)

As shown in table 1, ISs should be accessible, complete, correct, flexible, timely, relevant, reliable, accurate, and secure (Stair & Reynolds, 2018). The VC contributors should consist of data, the processes to transform the data, and the information needed for decision-making activities (Coronel & Morris, 2016).

Equally, the circular IS VC attributes for successful systems are telecommunications networks, data, hardware, software, people, and security (Laudon & Laudon, 2016). The systems must have top-down and bottom-up abilities (Valacich & Schneider, 2018). Together, these attributes serve as the requirements for the systems accountable to transform data into output in the form of information for decision-making activities toward sound financial management practices.

2.2.2. Critical Success Factors of a Successful Information System Value Chain

CSFs are also branded as key results areas, which refer to the elements that are mandatory for organisational achievements and successes (Jahangirian et al., 2017). Successful IS VCs in the public sector are significant capabilities that support the efforts of the sector towards a scenery that directs decision-making activities. Successful IS VCs for the public sector are primarily assessed according to the IS CSFs, VC CSFs, and the public sector CSFs. As a collective, these important CSFs must be realized for IS VCs in the public sector to be successful. This is an important competence that directs the public sector's actions toward sound financial management (Mithas et al., 2011).. Table 2 illustrates the CSFs applicable to ISs VC in the public sector.

Table 2. Critical Success Factors of a successful information system value chain

	Critical Success Factors	**Description**	**Authors**
Information System	Information quality	The anticipated features of the IS output	Aini et al. (2020)
	IS quality	The anticipated features of ISs	Puspitarini et al. (2018)
	Service quality	The suitable support received by users of the IS	Wei and Loong (2009)
	General usage	The degree to which users utilise the ISs in operation	DeLone and McLean (2016)
	User satisfaction	The users' satisfaction with the ISs	Jeyaraj (2020)
	Holistic benefit	The general value realised from the ISs	Chien and Tsaur (2007)
Value Chain	Value chain quality	The anticipated features of the VC output	Mascarenhas et al. (2004)
	Overall value	The general value realised from the VC	Walters and Lancaster (2000)
	Efficiency	The ability to produce the anticipated output with the least amount of input	Kaplinsky and Morris (2014)

	Effectiveness	The extent to which the VC can produce the anticipated output	Kumar and Rajeev (2016)
Public Sector	Economic growth	Economic growth rate of a country	Fourie and Burger (2019)
	Decent work	Fair work opportunities	Blustein et al. (2019)
	Unemployment reduction	Number of employable individuals without work opportunities	Parkin et al. (2012)

As shown in table 2, VCs in the sector should realize CSFs such as VC quality, overall value, efficiency, and effectiveness (Barber & Barber, 2008). Moreover, the ability of the public sector to create a favorable environment is dependent on the successful IS VCs that are in operation realizing the CSFs associated with the systems. IS VCs will only be deemed successful if the systems include the CSFs specific to the public sector: economic growth, decent work, and unemployment reduction that serve as confirmation of sound financial management practices (Cox & Schleier, 2010). Successful IS VCs in the public sector will only be deemed as such if the systems realize all CSFs that serve as input for the framework.

2.3. A Framework for Successful System Value Chains for Sound Provincial Financial Management

The IS VCs in operation directs the activities in public sector organisations towards sound financial management practices (Barata & Cain, 2001). The public sector's decision-making activities are directed by successful IS VCs. The public sector will persist with investments in systems that are mandatory for decision-making activities (Alipour et al., 2017). The evident IS VCs in operation will only be deemed successful if the systems comprise all the attributes and realise the CSFs. In so doing, the public sector will enable an environment that is conducive to economic growth, job creation, and poverty reduction based on actions, therefore, serving as confirmation that sound financial management practices are maintained. Figure 1 illustrates the framework that consists of the attributes and CSFs as outlined in tables 1 and 2.

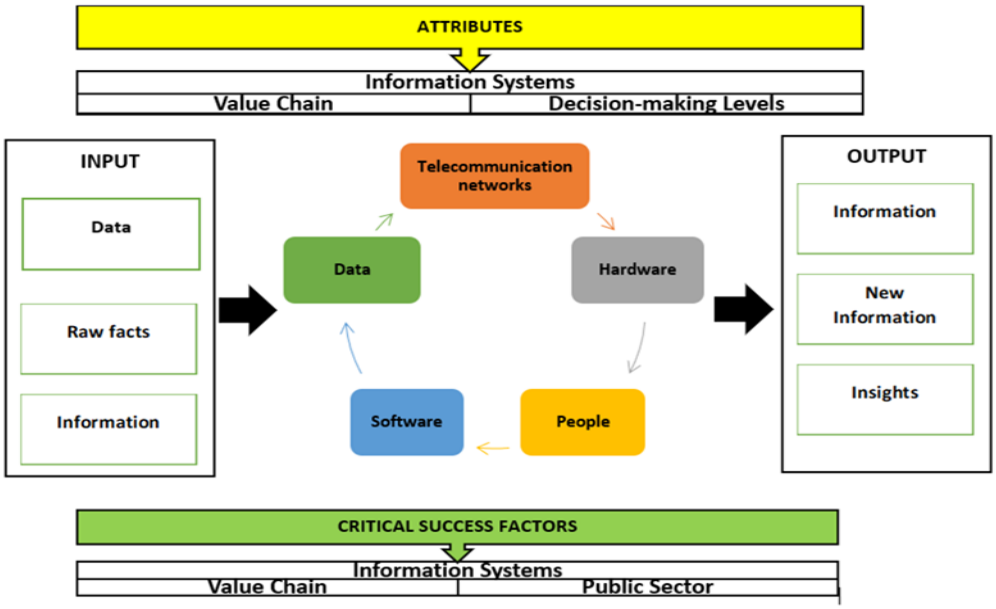

Fig. 1. Framework for a successful information system value chain in the public sector

Figure 1 shows that successful IS VCs in the public sector should resemble a circular model that possess all the attributes and realize the CSFs presented in table 1 and table 2. These serves as the input needed for the framework towards sound financial management practices ensures that resources are directed and used as intended (Ramphal, 2017). A framework may be a layered

assembly of interrelated elements that stipulates the necessities for achieving an anticipated outcome (Motevali Haghighi & Torabi, 2018). The framework comprises: (i) the circular IS VC, (ii) the mandatory attributes, and (iii) the CSFs that must be present for the systems responsible for providing crucial information for decision-making activities that direct sound financial practices.

2.3.1. Success Information System Value Chain Attributes

The framework shows that successful systems should be like a circular IS VC that consists of all the attributes of the first layer (see figure 1). This consists of attributes such as people, hardware, telecommunication networks, software, data, and security (see table 1) (Laudon & Laudon, 2016). This forms the foundation for the systems needed as per the framework. Therefore, serving as the circular model needed for the IS VCs accountable for a setting that is favorable for decision-making activities (Hasan Al-Mamary et al., 2014; Laudon & Laudon, 2016; Rosenblatt, 2014; Valacich & Schneider, 2018; Valdar, 2017).

The framework shows that successful IS VCs should consist of all supplementary attributes that form part of the second layer (see figure 1). This includes attributes associated with the ISs, VCs, and decision-making levels in the public sector. An IS will only be deemed successful if it is accessible, complete, correct, timeous, relevant, reliable, accurate, and secured (see table 1) (Bianchi & Trimigno, 2019; Cho et al., 2015; Forsgren et al., 2016; Georgiadis, 2019). These are the attributes needed for a VC to be successful in producing value for decision-making activities in the public sector (Coronel & Morris, 2016; Kruse et al., 2016; Valacich & Schneider, 2018).

The significant information accessible in the public sector is primarily used for operational and strategic decision-making activities (Abahmane & Binkkour, 2008). The IS VCs will only be deemed successful if it is capable to distribute output from the bottom-up for operational decisions and top-down for strategic decision-making activities. This requires information to be accessible based on the needs associated with operations for short-term planning. Also, for strategic activities, this necessitates for information to be distributed from the top through the various support levels for long-term planning (Valacich & Schneider, 2018). Therefore, serving as the decision levels capabilities needed for decision-making activities as per the evident decision levels (Schwalbe, 2016).

2.3.2. Success Information System Value Chain Critical Success Factors

The framework shows that successful IS VCs should realize all the CSFs that form part of the third layer of the framework (see figure 1). This consists of the CSFs associated with ISs, VC, and the public sector for the systems required for decision-making activities (see table 2). An IS will only be deemed successful if information quality, IS quality, service quality, general usage, user satisfaction, and holistic benefits serve as CSFs that are allied with the system. Also, the VCs in the public sector will only be deemed successful if VC quality, overall value, efficiency, and effectiveness are realized. These are the mandatory CSFs that must be realized for the IS VCs to be deemed successful (Jones & George, 2020).

The public sector in South Africa is in the forefront to enable a setting that is favorable for economic growth and unemployment reduction through decent work opportunities while maintaining sound financial management and governance practices. These are the CSFs specific to the public sector that must be realized for the IS VCs to be deemed successful. Consequently, serving as key results areas needed for sustainable economic growth towards unemployment reduction through the creation of decent employment opportunities (Nilsson et al., 2016). Accordingly, the ISs VC in the public sector will only be deemed successful if the system resembles the framework for the successful implementation and usage of the systems needed for decision-making activities.

3. Research Methodology

Pragmatism focuses on the practical conclusions of our thoughts and doings as an outcome to the research problem that was used for the research study (Cohen et al., 2018). A deductive approach was used to explore the current known theories or phenomena to establish their validity and applicability to this study (Saunders et al., 2012). Yin (2009) acclaims that where predominant literature is used to formulate research questions and objectives, the academic propositions informed it, may be used to formulate a framework. Furthermore, an inductive approach was followed to formulate the new insights needed to express the underlying themes, insights and understanding (Bahari, 2010).

A case study strategy that involves an empirical review of a specific present occurrence in a real-life setting was undertaken (Yin, 2018). A sample of 20 participants was identified (Cohen et al., 2018). The purposive sample approach chosen necessitated the identification of contributors across all levels (Cohen et al., 2018). Through this understanding, findings, conclusions, and recommendations were formulated. Table 3 illustrate the participants for the research study.

Table 3. Research respondents from public sector organisation

Position	Level	Years of Experience	Identifier	Duration of Interview
Directors	Strategic	22	PISVC01	00:29:57
Deputy Directors	Operational	14	PISVC02	00:28:45
Deputy Directors	Operational	13	PISVC03	00:29:52
Deputy Directors	Operational	13	PISVC04	00:23:14
Directors	Strategic	15	PISVC05	00:17:38
Chief Directors	Strategic	25	PISVC06	00:29:58
Executive	Strategic	24	PISVC07	00:34:32
Directors	Strategic	31	PISVC08	00:21:21
Practitioners	Operational	16	PISVC09	00:26:45
Deputy Directors	Operational	13	PISVC10	00:26:25
Directors	Strategic	20	PISVC11	00:31:51
Assistant Directors	Operational	6	PISVC12	00:22:22
Directors	Strategic	21	PISVC13	00:26:58
Assistant Directors	Operational	12	PISVC14	00:24:17
Directors	Strategic	21	PISVC15	00:26:47
Chief Directors	Strategic	19	PISVC16	00:23:25
Chief Directors	Strategic	26	PISVC17	00:21:08
Executive	Strategic	20	PISVC18	00:39:09
Directors	Strategic	18	PISVC19	00:29:25
Chief Directors	Strategic	25	PISVC20	00:29:00
	Average years	**19**	**Total**	**09:02:49**

Table 3 shows the actual participants with a 100% participation rate as planned, resulting in over nine hours' worth of data. To ensure that quality was achieved, reflexivity, dependability, confirmability, credibility, and transferability were maintained as follows.

- To maintain reflexivity, the relationship between the researcher and participants did not influence the data collection process and professionalism was maintained (Flynn et al., 2019).
- To maintain dependability, all interviews were transcribed verbatim and edited as per the recordings from the interviews with input only being mapped to a maximum of three attributes or CSFs where applicable (Elliott, 2018; Forero et al., 2018; Mårtensson et al., 2016).
- To maintain confirmability, recordings, transcripts, and thematical data were saved and stored on a password-protected laptop (Johnson et al., 2020).
- To maintain credibility, all insights, findings, recommendations, and conclusions are based on the actual data set saved and stored on a password-protected laptop (Kalu, 2017).
- To maintain transferability, all insights, findings, recommendations, and conclusions will be available and transferrable to similar settings with different participants (Moon et al., 2016).

A test interview was conducted to ensure that the participants and the researcher understood the questions and possible probing questions (Turner III, 2010). Standardization was maintained through the creation of a script for the interviews (Saunders et al., 2012). The research questions and possible probing questions were shared electronically in advance (Alshenqeeti, 2014). After consent was granted, the interviews were recorded and transcribed verbatim (Knox & Burkard, 2009).

To analyze the data, a deductive and inductive research analysis approach was followed (Saunders et al., 2012). Line numbers were included for all transcripts (Richards & Hemphill, 2018). This was followed by a color-coding process to group the responses. Yellow was used for the responses that related to attributes. Bright green was used for the responses that related to CSFs. Turquoise was used for the responses that outlined how these factors affect a successful IS VC in the public sector (Stranges et al., 2014).

A thematic analysis process in line with the qualitative data analysis method was applied (Stranges et al., 2014). The bold data informed by the data coding exercise was copied and placed under the relevant columns. The significant quotes of interest were identified and copied as input of interest in the tables of attributes and CSFs (Saunders et al., 2012).

4. Findings and Discussion

The paper represents the findings, recommendations, and conclusions for a case undertaken in a provincial government department that is responsible to oversee sound financial management and governance practices. This serves as the input for the attributes and CSFs mandatory to formulate the framework that will serve as a benchmark for the successful implementation and usage of IS VCs in the public sector.

4.1. Attributes of Successful System Value Chains for Sound Provincial Financial Management

The term attribute refers to a feature or quality that is seen as an important characteristic or part (Coronel & Morris, 2016). The research study sought to recognize the attributes of successful IS VCs in the public sector organization (table 4). Attributes or CSFs cited by 10 or more participants were categorised as significant and highlighted in green. Those cited by more than five but fewer than 10 participants were categorised as important but not significant for IS VCs in the public sector and highlighted in yellow. Those cited by five or fewer participants were categorised as insignificant and highlighted in red (Akinyode & Khan, 2018). Further detail regarding the attributes and supporting interview data is presented in Appendix A.

Table 4. Summary of attributes of a successful information system value chain

	Attributes	**Number of Responses**	**Standard Label**
Information System Attributes	Reliability	13	Significant
	Relevance	13	Significant
	Accuracy	13	Significant
	Completeness	12	Significant
	Correctness	12	Significant
	Accessibility	10	Significant
	Timeliness	10	Significant
	Security	7	Important but not significant
	Flexibility	5	Insignificant
Value Contributors	Data	17	Significant
	Process	16	Significant
	Information	15	Significant
Circular Information System Value Chain	Data	17	Significant
	Hardware	11	Significant
	Software	11	Significant
	People	10	Significant
	Telecommunications network	10	Significant
	Security	7	Important but not significant

Table 4 shows the attributes that were labeled as significant as per the standard adopted for the research study (Akinyode & Khan, 2018). Therefore, confirming that successful IS VCs in the public sector should consist of the attributes associated with ISs, VC contributors and the circular IS VC. Consequently, successful ISs VC will only be deemed as such if the systems possess all the attributes associated with ISs, VC contributors and the circular IS VC (DeLone & McLean, 2016). These include attributes such as reliability, relevance, accuracy, completeness, correctness, accessibility, and timeliness that are associated with ISs. Also, attributes associated with the VC contributors includes data, processes and information (Coronel & Morris, 2016).

Furthermore, attributes such as data, hardware, software, people, and telecommunication networks are the mandatory attributes that the circular model for sound

financial management and governance practices should possess. These attributes become the attributes for the framework for the successful implementation and usage of IS VCs towards sound financial management and governance practices.

On the other hand, the attributes labeled as important but not significant and insignificant are associated with ISs, circular IS VCs, and decision-making levels. This includes attributes such as security, flexibility, and top-down and bottom-up abilities. These attributes are arguably not required for the framework for the successful implementation and usage of IS VCs in the public sector organisation as per the responses received. However, due to the needs that successful IS VCs in the public sector address and the attributes in question, these should be investigated further in future research.

4.2. Critical Success Factors of a Successful System Value Chains for Sound Provincial Financial Management

The term CSFs refers to the anticipated variables that are mandatory for success to be associated with the matter of interest (Bullen & Rockart, 1981). The research study sought to recognize the CSFs of successful IS VCs in the public sector organization (table 5). Further detail regarding the CSF and supporting interview data is presented in Appendix B. This shows the CSFs that were labeled as significant as per the standard adopted for the research study (Akinyode & Khan, 2018).

Table 5. Summary of critical success factors of a successful information system value chain

	Critical Success Factors	Number of Responses	Standard Label
Information System	IS quality	18	Significant
	Information quality	16	Significant
	Service quality	16	Significant
	Holistic benefit	15	Significant
	User satisfaction	14	Significant
	General usage	6	Important but not significant
Value Chain	Overall value	14	Significant
	VC quality	12	Significant
	Efficiency	6	Important but not significant
	Effectiveness	5	Insignificant

Table 5 shows the CSFs that were labeled as significant as per the standard adopted for the research study (Akinyode & Khan, 2018). Therefore, confirming that the successful IS VCs in the public sector organisation should consist of the CSFs associated with ISs and VCs. These include CSFs such as IS quality, information quality, service quality, holistic benefit, user satisfaction, overall value, and VC quality that are allied with ISs and VCs correspondingly. Consequently, the IS VCs in the public sector organisation will only be deemed successful if the systems realise the CSFs associated with ISs and VCs as established from the data collected from the respondents (Aini et al., 2020). These CSFs serve as the requirements for the IS VCs in the public sector organisation. In so doing, becoming the CSFs needed for the framework for the successful implementation and usage of IS VCs towards sound financial management and governance practices.

On the other hand, two CSFs were labeled as important but not significant and one CSF was labeled as insignificant. This includes CSFs such as general usage, efficiency, and effectiveness. These CSFs are arguably not required however, due to the needs that successful IS VCs in the public sector organisation address and the nature of the CSFs, these should be investigated further in future research.

4.3. Factors Affecting a Successful System Value Chains for Sound Provincial Financial Management

The research study sought to establish the effect of the attributes and CSFs on successful IS VCs in public sector organisation. Accordingly, ISs should include attributes such as reliability, relevance, completeness, correctness, accessibility, and timeliness. Also, the system should include attributes such as data, process, and information for a VC. Lastly, the circular model should

include attributes such as data, hardware, software, people, and telecommunications networks. These are the attributes that serve as input for the framework for the successful implementation and usage of IS VCs towards sound financial management and governance practices. This suggests that the attributes are significant and signify their effect on successful IS VCs in the public sector organisation. According to Laudon and Laudon (2016), successful IS VCs in the public sector are assessed as per the attributes associated with the ISs, VC contributors, and their ability to operate as a circular IS VC. Collectively, these attributes serve as the requirements for the formulation of the framework for the successful implementation and usage of IS VCs toward sound financial management and governance practices.

According to Trkman (2010), CSFs are the fundamentals that successful IS VCs in the public sector organisation must realise. The ISs must realize the CSFs such as IS quality, information quality, service quality, holistic benefit, and user satisfaction. Likewise, the VC must realize CSFs such as overall value and VC quality. This suggests that the CSFs are significant and signifies their effect on successful IS VCs in the public sector organisation. According to Wijayanto (2020), this suggests that the confirmed CSFs associated with successful ISs and VCs have a direct bearing on the ISs VC in the public sector origination. Collectively, these CSFs serve as the requirements for the framework for the successful implementation and usage of IS VCs towards sound financial management and governance practices.

4.4. Framework for the Successful Implementation and Usage of Information System Value Chains for Sound Provincial Financial Management

The overall aim of this research study was to explore and articulate the attributes and CSFs of a successful information systems value chain in the public sector of a developing nation. The subsequent output is a framework formulated for the successful implementation and usage of IS VCs that will serve as a benchmark for the public sector. The factors of significance that apprises successful ISs VC in the public sector organisation were confirmed as per tables 4 and 5. The findings from Tables 4 and 5 serve as input for the formulation of the framework that serves as the requirements for the systems needed for decision-making activities toward sound financial management and governance practices. According to Martins et al. (2019), the public sector's actions are significantly reliant on successful IS VCs for decision-making activities. The IS VCs for the public sector organisation will only be perceived as successful if the systems possess the attributes and realise the CSFs as confirmed by the contributors from the participating public sector organisation (DeLone & McLean, 2016). Figure 2 illustrates the framework for the successful implementation and usage of IS VCs toward sound financial management practices.

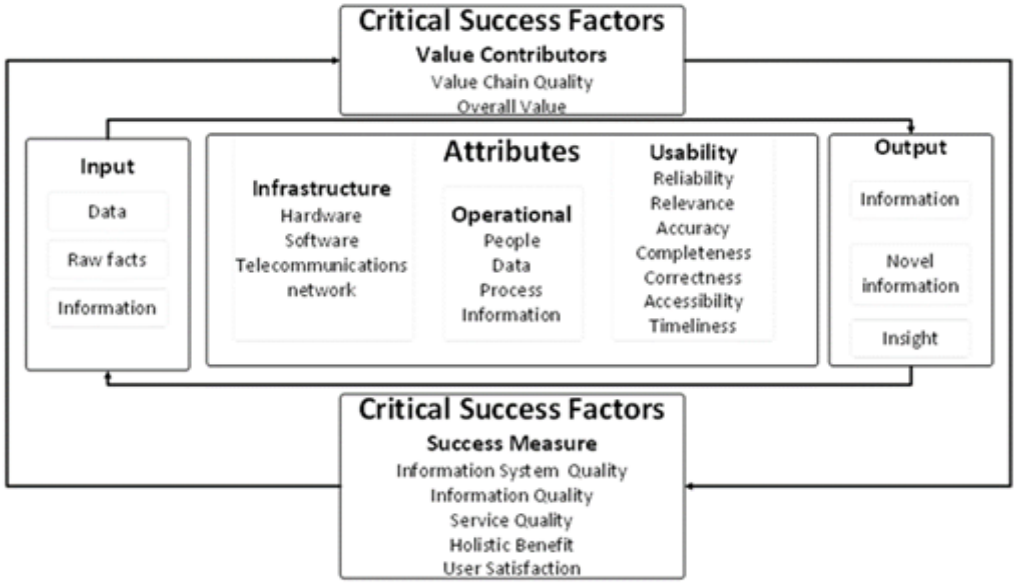

Fig. 2. Framework for the successful information system value chain in the public sector

The confirmed attributes and CSFs highlighted additional fundamental themes for the public sector organisation. A theme can be defined as an idea that exists because of an underlying patterns (Bryman, 2012, p. 580). Expanding on the coding and thematic analysis of the data (Stranges et al., 2014), five themes were identified across the attributes and CSFs.

Three fundamental themes are associated with attributes that must be addressed for the successful ISs VC in the public sector organisation: (i) infrastructure, (ii)

operational, and (iii) usability. Suitable infrastructure must be in place to support the needs that exist in the organisation. This is shadowed by the operational activities mandatory for the information needed. Also, the usability of the IS VCs in operation serves as the assurance needed for the systems in the public sector organisation to be deemed successful. The usability theme offers assurance from the user's point of view. Accordingly, the infrastructure, operational, and usability themes, become the requirements for the attributes mandatory for successful IS VCs towards sound financial management and governance practices.

Also, two fundamental themes associated with CSFs must be addressed for the successful ISs VC in the public sector organisation: (i) value contributors and (ii) success measures. The value contributor theme suggests that the IS VCs operation delivers value in the form of information through an arrangement of activities for decision-making activities. Likewise, the success measure theme serves as the assurance mandatory and serves as confirmation that the IS VCs in operation realizes satisfactory information. Figure 3 adapts Laudon & Laudon (2016) to illustrate how the five fundamental themes can enable the successful implementation and usage of IS VCs in the public sector organisation.

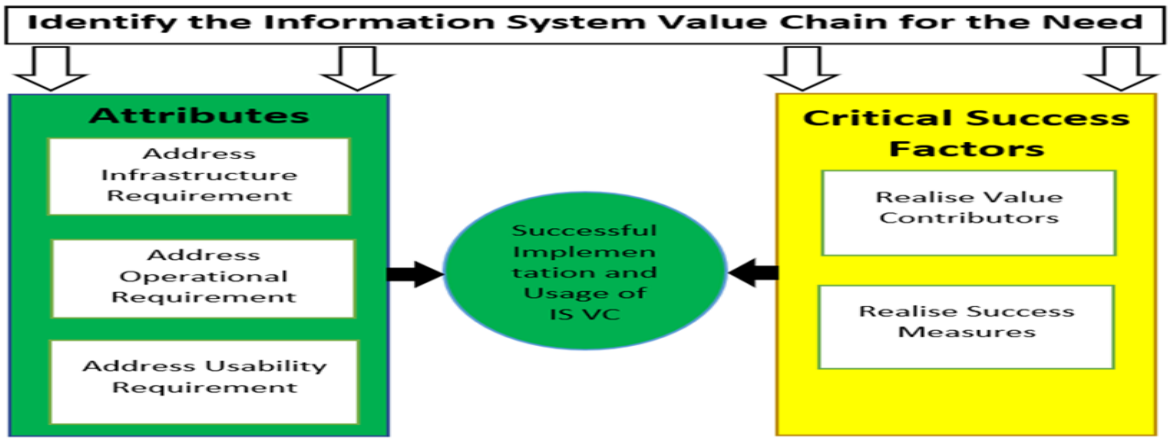

Fig. 3. Applying the themes for the framework of information system value chain in the public sector

The successful ISs VC in the public sector organisation serves as the source of the information needed for decision-making activities toward sound financial management and governance practices. Consequently, the public sector organisation should be able to implement IS VCs that are successful by adopting the framework. Therefore, ensuring that decision-making activities are well informed therefore resulting in sound financial management and governance practices

4.4.1. Practical Application: Attributes for the Framework

The infrastructure theme comprises attributes such as hardware, software, and telecommunications networks. The theme is accountable for the collection, processing, creation, storage, and distribution of information to authorized users. According to Valacich and Schneider (2018), the infrastructure theme attributes serve as the foundation for successful IS VCs for the public sector organisation. Through this theme efficiencies, effectiveness and agility are enabled. These are the requirements for successful IS VCs towards sound financial management and governance practices (Roşca et al., 2010). According to Al-Mamary et al. (2014), successful IS VCs in the public sector organisation must include the attributes allied with the infrastructure theme for it to be considered successful.

The operational theme comprises attributes such as people, data, processes, and information. The theme is accountable for the operationalization of the actions needed to transform data into information as argued by Schwalbe (Schwalbe, 2016). These attributes are mandatory for successful IS VCs to produce information for decision-making activities toward sound financial management and governance practices (Rosenblatt, 2014). According to Barber and Barber (2008), successful IS VCs in public sector organisations will only be deemed successful if the system consists of all the operational theme attributes as stated. Furthermore, Coronel & Morris (2016) argue that this theme provides valuable information that is required for decision-making activities in public sector organisations

The usability theme comprises attributes such as reliability, relevance, accuracy, completeness, correctness, accessibility, and timeliness. The theme is accountable for the overall experience of the user. These attributes may be associated with the users' satisfaction levels and are based on the users' overall experience of the successful IS VCs in public sector organisations (Forsgren et al. 2016). According to Laumer et el. (2017), the theme is

associated with service quality, which serves as an indication of the users' net benefits. Therefore, serving as confirmation from the user's perspective (Bianchi & Trimigno, 2019). The usability theme aligns with Zaied (2012) who argues that the theme's attributes produce the information needed for decision-making activities. Collectively, the three themes consist of 15 confirmed attributes that are mandatory for the framework that serves as a benchmark for the successful implementation and usage of IS VCs towards sound financial management and governance practices.

4.4.2. Practical Application: Critical Success Factors for the Framework

Seven CSFs were confirmed as significant and are the minimum requirements that must be included for public sector organisations. These brought to light two themes: (i) value contributors and (ii) success measures. Accordingly, public sector organisations should ensure that the IS VCs in operation includes all the CSFs as confirmed by the participants from the public sector organisation.

The value contributor theme comprises of CSFs such as overall value and VC quality. Including the CSFs associated with the value contributor theme confirms that value is produced by the IS VCs when transforming the raw facts into information required for decision-making activities in public sector organisations. For IS VCs in the public sector to be deemed successful, all value contributors in the chain must add some value to the overall value of the system (Barber & Barber, 2008). Jones and George (2020) further argue that these are the CSFs that must be present for the system to be deemed successful. As argued by Cox and Schleier (2010), successful IS VCs in the public sector organisation are mainly evaluated as per the effectiveness, quality, and efficiency that comes from the chain of activities when producing information for sound financial management and governance practices.

Lastly, the success measure theme comprises of CSFs such as IS quality, information quality, service quality, holistic benefit, and user satisfaction. According to Wijayanto (2020), the successes of the IS VCs are mainly evaluated by the system's ability to realize the CSFs associated with it. Jeyaraj (2020) asserts that metrics are valid for evaluating the success of IS VCs as these are the key result areas that serve as the benchmark for IS VCs in public sector organisations to be perceived as successful. Jointly, the two fundamental themes and seven CSFs serve as confirmed key result areas that must be realized for successful IS VCs towards sound financial management and governance practices.

organisations should include being deemed successful. The CSFs associated with the value contributor

5. Conclusions

The research study sought to identify the attributes and CSFs of successful IS VC in the public sector. The study was undertaken through a case study in a public sector department at a provincial level. Interviews were conducted with participants from both operational and strategic levels in response to the research study. This resulted in the insights, knowledge, findings, underlying themes, recommendation, and conclusions that informed the framework for the successful implementation and usage of IS VC towards sound financial management and governance practices.

The first objective of this research study was to better understand the attributes of a successful IS VC in the public sector. As confirmed by the participants from the public sector organisation, successful IS VCs require 15 attributes (table 4) that are the minimum requirements for public sector organisations. These attributes brought to light three underlying themes (figure 2), namely infrastructure, operational, and usability, which are requirements for successful IS VCs in the public sector. The infrastructure theme consists of the attributes, namely hardware, software, and telecommunications network (figure 2). These three attributes are the foundation of the systems and permit efficiencies, effectiveness, and agility which must be addressed by the IS VCs required for decision-making activities in public sector organisations. The operational theme consists of four attributes, namely data, people, process, and information (figure 2). These represent the attributes that are necessary and must be included to transform the vast array of data into information important for decision-making activities. The assurance from the end-users serves as the confirmation that the IS VCs in public sector organisations are successful. The usability-themed attributes are the required confirmation from the users' perspective and must be included for the IS VCs to be deemed successful. The usability theme consists of seven attributes, namely reliability, relevance, accuracy, completeness, correctness, accessibility and timeliness (figure 2). For IS VCs in the public sector to be deemed successful, the systems in operation should include all the attributes associated with the infrastructure, operational and usability themes.

The second objective of this research study was to better understand the CSFs of successful IS VCs in the public sector. Seven CSFs (table 5) were confirmed as significant by the participants from the public sector organisation. These CSFs brought to light two underlying themes (figure 2), namely value contributors and success measures. Public sector organisations should ensure that the IS VCs in operation includes all the CSFs as confirmed by the participants from the public sector organisation. The value contributor theme consists of the CSFs of VC quality and overall value (figure 2), which the systems in operation in the public sector

theme confirm that value is produced by the IS VCs when transforming the raw facts into information required for decision-making in the public sector. The success measure theme consists of the CSFs, namely IS quality, information quality, service quality, holistic benefit, and user satisfaction (figure 2). These CSFs must be included for the IS VCs in public sector organisations to be perceived as successful. These CSFs become the key result areas that serve as the benchmark in IS VCs in public sector organisations for them to be perceived as successful.

It is recommended that public sector organisations adopt the practical application of the framework which should be the minimum requirements for the successful IS VCs in operation for information required for decision-making activities. In so doing, public sector organisations will be able to implement and use IS VCs in accordance with the benchmark set by the research study. The information required for decision-making activities will then also be in accordance with the benchmark set for IS VCs in the public sector. This will result in well-informed decisions that will create an environment that is conducive to sustainable economic growth and decent job creation for the betterment of all citizens.

The research study observed the qualitative research methods and standards. As a result of the in-depth interviews needed, the research study was constrained to a small sample. The study was restricted to participants from a public sector organisation at the provincial level in South Africa that serves as a representation of the sector. The limited time for the research study influenced the overall outcomes of the research study and specific important characteristics might have been omitted. A lack of academic literature specific to the public sector on the subject matter was also a constraint. The study was restricted to a specific public sector department with the data, insights, conclusions, and recommendations stemming from the study being applicable to similar public sector organisations. The restrictions observed because of the COVID-19 pandemic influenced the approach opted for as a standard for the interviews. This removed the one-on-one in-person collaboration needed for research studies like this.

In conclusion, the research study established how these themes should be realized as part of the framework for the successful implementation and usage of IS VCs towards sound financial management and governance practices. The framework serves as a benchmark for public sector organisations at a provincial level in South Africa. Conversely several attributes and CSFs were labeled as important but not significant and insignificant for the public sector organisation. This includes attributes such as security flexibility, top-down and bottom-up abilities. Also, this includes CSFs such as general usage, efficiency, effectiveness, economic growth, decent work, and unemployment reduction. Due to the nature of the public sector organisation and the attributes and CSFs in question, these should be explored in future research studies. Therefore, contributes to a more inclusive framework for the successful implementation and usage of IS VCs towards sound financial management and governance practices.

DOI: 10.6977/IJoSI.202212_7(4).0002
N. Joseph / Int. J. Systematic Innovation, 7(4), 18-38(2022)

Appendix A. Attributes of a successful information system value chain

	Attributes	Participant Identifier	Transcript Directly Quoted Evidence
Information System Attributes	Reliability	PISVC04	"It highlights if the information system is reliable."
		PISVC16	"Give assurance on the information that we are reporting on, so accuracy, relevance and reliability."
		PISVC20	"If we have data or maybe information that is correct and accessible, relevant and reliable as well as accurate and where that information is available on time, then those will be your key attributes to successful information."
	Relevance	PISVC01	"It must be able to give us relevant information."
		PISVC08	"I would say that you would need to have access to the relevant data."
		PISVC15	"Information coming out of that to feed into our decision-making must be relevant."
	Accuracy	PISVC01	"It must give us accurate information."
		PISVC03	"Accuracy would be an attribute and the information has to be accurate."
		PISVC15	"Accurate, verifiable, flexible, uh, information and usable information at cost effective and very efficient so that the information remains relevant."
	Completeness	PISVC13	"Important attribute would be completeness of the information system."
		PISVC15	"Accurate, verifiable, flexible information and usable information at cost effective and very efficient so that the information remains relevant."
		PISVC20	"It should be complete, accurate and relevant and all those things and timely, so that's for me, information system relates to that."
	Correctness	PISVC05	"Is it reliable and credible."
		PISVC12	"That data is now trusted, consistent accurate with facts and verify and verifiable."
		PISVC20	"If we have data or maybe information that is correct and accessible, relevant and reliable as well as accurate and where that information is available on time, then those will be your key attributes to successful information."
	Accessibility	PISVC01	"So that information should be able to you should be able to retrieve and work."
		PISVC03	"Maybe, usability and accessibility like the ease of use of the system."
		PISVC15	"It must also be accessible to those that I want to be accessible to."
	Timeliness	PISVC01	"They must be timely in the sense that if I want something, I should not be able I should not wait for, I don't know, two days to get it."
		PISVC11	"And being able to provide you with that data as and when you require it."
		PISVC15	"It must have timelines."
Value Chain Contributors	Data	PISVC02	"When we say information system, information or raw data will be one of the components."
		PISVC14	"Successful attribute would be a system that is able to collect data."
		PISVC15	"Firstly, are data sources, where are we getting this information."
		PISVC07	"When combined through that process or system that gathers and gets rid of that information into something."

	Process	**PISVC12**	"Store data and process the data and analyse data and distribute information."
		PISVC19	"It's processes to integrate the flow of information to be able to make meaningful sense."
	Information	**PISVC03**	"Allowing people to access information and data and using it that that that data or that information."
		PISVC09	"We call that the inputs and the also to process that information and the output."
		PISVC14	"It's a platform where information can be process or data can be processed into information."
Circular Information Systems Value Chain Attributes	**Data**	**PISVC05**	"Is hosted how the information system transfer and connect data."
		PISVC16	"A database that will take raw data."
		PISVC20	"If we have a data or maybe information that is correct."
	Hardware	**PISVC02**	"The attributes of a successful information value in the public sector, Include the computer hardware."
		PISVC13	"Most of the time it is what you call it, an ICT system embedded in an ICT system."
		PISVC18	"I mean just then there the system you know the physical or IT system."
	Software	**PISVC03**	"Uh, then there's a tech which comprises of your software and your hardware."
		PISVC12	"I'm thinking of this completeness. Which is the software."
		PISVC18	"I mean just then there the system you know the physical or IT system."
	People	**PISVC02**	"And lastly, the officials involved from the start to the end of the value chain."
		PISVC11	"Uh, successful information system so that you can get to work with, other, uh, stakeholders."
		PISVC20	"You need people to be working on the system who are knowledgeable of course."
	Telecommunications Network	**PISVC05**	"This system will then talk to connectivity."
		PISVC11	"You also look at the infrastructure."
		PISVC16	"The infrastructure because it requires infrastructure."

DOI: 10.6977/IJoSI.202212_7(4).0002
N. Joseph / Int. J. Systematic Innovation, 7(4), 18-38(2022)

Appendix B: Critical success factors of a successful information system value chain

	Critical Success Factors	Participant Identifier	Transcript Directly Quoted Evidence
Information System	IS quality	PISVC06	"It's of high quality, it's reliable, and as such, at the end of the day, we can achieve."
		PISVC18	"You know, then, the decision makers with that type of information for them to make right decisions."
		PISVC20	"And I think if all those critical factors are taken into consideration and as the public sector, we do have an information system that is working, which would be easy for the public sector to be able to look at priorities."
	Information quality	PISVC05 (273-275	"To enable extraction of this data as to allow for correct reporting and also enable for proper decision-making in terms of the value chain in the public sector."
		PISVC16	"Remember the information that is coming from the financial system will assist with the reporting and that reporting will be audited."
		PISVC20	"As well as making it easier to achieve your objectives where information can be built into a system and that information assist management in taking informed decisions."
	Service quality	PISVC03	"It can be a means of accessing, storing and presenting data. It can be the actual uhm, how can I say the I don't wanna say process again? But essentially a means of, uh, allowing people to access information and data and using that data or that information in a constructive way. Whether it be strategically, it could be a routine process."
		PISVC08	"One is able to improve that service all the time."
		PISVC19	"Information managing management systems and be able to derive the value at the end of the of the process."
	Holistic benefit	PISVC01	"It's basically that type of information that is used by an organisation in its daily operations all the way up to a strategic level, I think."
		PISVC03	"But essentially a means of, allowing people to access information and data and using it that data or that information in a constructive way. Whether it be strategically, it could be a routine process."
		PISVC20	"Information system that is able to assist you, in meeting the operational requirements and saving you on cost and, uh, enabling you to report timeously, then that should be deemed as a successful information system."
	User satisfaction	PISVC02	"Is it easy to maintain this system? And then there's service ability as well of the information system, remember when you when you do the information system, you also install the third-party software in your system, in your, in, you're in your environment. So, is it, is it easier to service those software's?"
		PISVC06	"Something that even someone with the lowest level of education can access that system and it's user friendly in terms of inputting whatever information."
		PISVC15	"It must also be time bound and flexible and easy to access. Easy to interpret. That will then speak to the usability of that information."
Value Chain	Overall Value	PISVC01	"I think for any value chain to work, the one system must be able to work with the next or into the interconnecting factors."

		PISVC19	"And it has got a value to add to the whole process or the whole chain. Uh, and it may be one of the dependence or interdependence that will contribute to the whole."
		PISVC20	"Information system that is able to assist you, in meeting the operational requirements and saving you on cost and, uh, enabling you to report timeously, then that should be deemed as a successful information system."
	Value Chain Quality	**PISVC03**	"So, what you would need is a constant revision economizing of your value chain process to make sure that other you're doing things most efficiently, cost-effectively or producing the best results you can out of the uh, number of inputs that you have in that chain."
		PISVC10	"It needs to have certain steps and within those steps value needs to derive therefrom."
		PISVC19	"And it has got a value to add in the whole process or in the whole chain. Uh, and it may be one of the dependence or interdependence that will contribute to the whole."

References

Abahmane, O. & Binkkour, M. (2008). Strategic and Operational information support of decision-making processes and systems. Proceedings of the Information Systems and Business Intelligence Conference, 1(1), 1–9.

Aini, S., Lubis, M., Witjaksono, W. R., & Azizah, A. H. (2020). Analysis of Critical Success Factors on ERP Implementation in PT. Toyota Astra Motor Using Extended Information System Success Model. 3rd International Conference on Mechanical, Electronics, Computer, and Industrial Technology (MECnIT), 1(1), 370–375.

Akinyode, B. F. & Khan, T. H. (2018). Step by step approach for qualitative data analysis. International Journal of Built Environment and Sustainability, 5(3), 163–174.

Al-Mamary, Y. H., Shamsuddin, A., & Aziati, N. (2014). Proposed model for the successful implementation of management information systems in Yemeni organisations. Journal of Management and Science, 4(3), 1279–1286.

Alipour, J., Karimi, A., Ebrahimi, S., Ansari, F., & Mehdipour, Y. (2017). International Journal of Medical Informatics Success or failure of hospital information systems of public hospitals affiliated with Zahedan University of Medical Sciences: A cross sectional study in the Southeast of Iran. International Journal of Medical Informatics, 108(1), 49–54.

Bahari, S. F. (2010). Qualitative versus quantitative research strategies: contrasting epistemological and ontological assumptions. Jurnal Teknologi, 52(1), 17–28.

Barata, K. & Cain, P. (2001). Information, not technology, is essential to accountability: Electronic records and public-sector financial management. Information Society, 17(4), 247–258.

Barber, E. (2008). How to measure the "value" in value chains. International Journal of Physical Distribution and Logistics Management, 38(9), 685–698.

Bianchi, P. & Trimigno, M. (2019). How does information system system success come about in inter-organisational networks of public services? Public Money & Management, 1(1), 1–10.

Blustein, D. L., Kenny, M. E., Di Fabio, A., & Guichard, J. (2019). Expanding the Impact of the Psychology of Working: Engaging Psychology in the Struggle for Decent Work and Human Rights. Journal of Career Assessment, 27(1), 3–28.

Bryman, A. (2012). Social Research Methods (4th ed.). New York: Oxford.

Bullen, C. V. & Rockart, J. F. (1981). A primer on critical success factorst. Massachusetts Institute of Technology, 1(69).

Cheruiyot, K., Katumba, S., & Wray, C. (2019). Patterns and correlates of dissatisfaction with government performance in the Gauteng city-region, South Africa: A comparison across three government spheres. Review of Regional Studies, 49(1),

1–26.

Chien, S. & Tsaur, S (2007b). Investigating the success of ERP systems: Case studies in three Taiwanese high-tech industries. Computers in Industry, 58(1), 783–793.

Cho, K., Bae, S., Ryu, J., Kim, K., An, C., & Chae, Y. (2015). Performance evaluation of public hospital information systems by the information system success model. Healthcare Informatics Research, 21(1), 43–48.

Cohen, L., Manion, L., & Morrison, K. (2018). Research Methods in Education (8th ed.). New York: Routledge Taylor & Francis Group.

Coronel, C. & Morris, S. (2016). Database Systems (12th ed.). Boston, MA: Cengage Learning.

Cox, J. F. & Schleier, J. G. (2010). Theory of Constraints Handbook. New York: McGraw-Hill Professional Publishing.

DeLone, W. H. & McLean, E. R. (2016). Information Systems Success Measurement. Foundations and Trends in Information Systems, 2(1), 1–32.

Dew, J. P. & Jian Xiao, J. (2011). The Financial Management Behavior Scale: Development and Validation. BYU ScholarsArchive, Faculty Publications, 1(1) 1-12.

Elliott, V. (2018). Thinking about the coding process in qualitative data analysis. Qualitative Report, 23(11), 2850–2861.

Flynn, S. V., Korcuska, J. S., Brady, N. V., & Hays, D. G. (2019). A 15-Year Content Analysis of Three Qualitative Research Traditions. Counselor Education and Supervision, 58(1), 49–63.

Forero, R., Nahidi, S., De Costa, J., Mohsin, M., Fitzgerald, G., Gibson, N., McCarthy, S., & Aboagye-Sarfo, P. (2018). Application of four-dimension criteria to assess rigour of qualitative research in emergency medicine. BMC Health Services Research, 18(1), 1–11.

Forsgren, N., Clay, P. F., Wang, X., & Durcikova, A. (2016). The integrated user satisfaction model: Assessing information quality and system quality as second-order constructs in system administration. Communications of the Association for Information Systems, 38(1), 803–839.

Fourie, F. & Burger, P. (2019). How to Think and Reason in Macroeconomics: A South African Text (5th ed.). Cape Town: Juta and Company.

Fourie, D. & Poggenpoel, W. (2017). Public sector inefficiencies: Are we addressing the root causes? South African Journal of Accounting Research, 31(3), 169–180.

Gauteng Provincial Government. (2022). Gauteng Provincial Government [Online]. Available: https://www.gauteng.gov.za/ [Accessed: 27 March 2022].

Georgiadis, E. (2019). An Integrated Theoretical Model of Information Systems Success/Technology Adoption for Systems Used by Employees in the 4 And 5-Star Full-Service Hotel Sector in the UK. Department of Food and Tourism Management, 1(1), 1–584.

Gersonskaya, I. (2020). Leading Role of the Public Sector in the Digitalisation of Economy. Advances in Social Science, Education and Humanities Research, 386 (Icsealv), 228–234.

Hasan Al-Mamary, Y., Shamsuddin, A., & Aziati, N. (2014). The Role of Different Types of Information Systems in Business Organisations: A Review by Yaser Hasan Al-Mamary, Alina Shamsuddin, A.H. Nor Aziati. International Journal of Research, 1(7), 333–339.

Jahangirian, M., Taylor, S. J. E., Young, T., & Robinson, S. (2017). Key performance indicators for successful simulation projects ga. Journal of the Operational Research Society, 68(7), 747–765.

Jeyaraj, A. (2020). DeLone & McLean models of information system success: Critical metareview and research directions. International Journal of Information Management, 1(1), 1–15.

Johnson, J. L., Adkins, D., & Chauvin, S. (2020). A review of the quality indicators of rigor in qualitative research. American Journal of Pharmaceutical Education, 84(1), 138–146.

Jones, G. R. & George, J. M. (2020). Contemporary Management (11th ed.). New York: McGraw-Hill Education.

Kalu, F. A. (2017). What makes qualitative research good research? An exploratory analysis of critical elements. International Journal of Social Science Research, 5(2), 43.

Kaplinsky, R. & Morris, M. (2014). A Handbook for Value Chain Research. Report prepared for IDRC, Canada. (Issue June).

Khominich, I., Rybyantseva, M., Borodacheva, L., Dik, E., & Afanasev, E. (2016). Financial management as a system of relations of the enterprise for highly efficient management of its finances. International Journal of Economics and Financial Issues, 6(8Special Issue), 96–101.

Knox, S. & Burkard, A. (2009). Qualitative Research Interviews. Article in Psychotherapy Research, 19(5), 566–575.

Kruse, S., Papenbrock, T., Harmouch, H., & Naumann, F. (2016). Data Anamnesis: Admitting Raw Data into an Organisation. IEEE Data Engineering Bulletin, June 8–20.Lovre

Kumar, D. & Rajeev, P. (2016). Value Chain: A Conceptual Framework. International Journal of Engineering and Management Sciences, 7(1), 74–77.

Laudon, K. & Laudon, J. (2016). Managing Information Systems (14th ed.). London: Pearson.

Laumer, S., Maier, C., & Weitzel, T. (2017). Information quality, user satisfaction, and the manifestation of workarounds: A qualitative and quantitative study of enterprise content management system users. European Journal of Information Systems, 26(4), 333–360.

Lee, N. (2015). Counterterrorism and Cybersecurity. In Counterterrorism and Cybersecurity. New York: Springer International.

Martins, J., Branco, F., Gonçalves, R., Au-yong-oliveira, M., Oliveira, T., Naranjo-zolotov, M., & Cruz-jesus, F. (2019). Telematics and Informatics Assessing the success behind the use of education management information systems in higher education. Telematics and Informatics, 38(1), 182–193.

Mascarenhas, O., Kesavan, R., & Bernacchi, M. (2004). Customer value-chain involvement for co-creating custom

Mithas, S., Ramasubbu, N., & Sambamurthy, V. (2011). How Information Management Capability Influences Firm Performance. Computer Sciences Commons, and The Management Information Systems Commons, 35(1), 237–256.

Motevali Haghighi, S., & Torabi, S. (2018). A novel mixed sustainability-resilience framework for evaluating hospital information systems. International Journal of Medical Informatics, 118(June), 16–28.

Mouton, J. (2002). Understanding Social Research (3rd ed.). Pretoria: Van Schaik.

Ndevu, Z. & Muller, K. (2017). A conceptual framework for improving service delivery at local government in South Africa. African Journal of Public Affairs, 9(7), 13–24.

Nilsson, M., Griggs, D., & Visbeck, M. (2016). Map the interactions between Sustainable Development Goals. Macmillan Publishers Limited, 534(1), 320–322.

Nuryanah, S. & Islam, S. (2015). Sound Financial Management Strategies for Achieving Good Corporate Governance Practices. Corporate Governance and Financial Management, Clarke 2004, 1–12.

Olivier, C. (2016). The Complexity of Budget Reform and Performance Management in the South African Public Sector Financial Environment. Administratio Publica, 24(4), 46–70.

Parkin, M., Bauer, P., Bruce-Brand, J., Kohler, M., Neethling, L., Rhodes, B., Saayman, A., Schoer, V., Scholtz, D., Thompson, K., & Van der Merwe, J. (2012). Economics: Global and Southern African Perspective. London: Pearson.

Purwita, A. & Subriadi, A. (2019). Information technology investment: In search of the closest accurate method. Procedia Computer Science, 161, 300–307.

Puspitarini, W., Handayani, P., Pinem, A., & Azzahro, F. (2018). Success Factors of Human Resource Information System Implementation: A Case of Ministry of State- owned Enterprise. Proceeding of EECSI 2018, Malang - Indonesia, 16-18 Oct 2018, 1, 16–18.

Ramphal, A. (2017). University of KwaZulu-Natal Analysis of the Financial Management Practices in the Provincial. 1–135.

Reddy, P. (2016). The politics of service delivery in South Africa: The local government sphere in context. The Journal for Transdisciplinary Research in Southern Arica, 12(1), 1–8.

Richards, K. & Hemphill, M. (2018). A practical guide to collaborative qualitative data analysis. Journal of Teaching in Physical Education, 37(2), 225–231.

Roşca, D., Bănică, L., & Sîrbu, M. (2010). Building Successful Information Systems – a Key for Successful Organisation. Economics and Applied Informatics, 1(1), 101–108.

Rosenblatt, H. (2014). Systems Analysis and Design (10th ed.). Boston, MA: Cengage Learning.

Ross, J., Stevenson, F., Lau, R., & Murray, E. (2016). Factors that influence the implementation of e-health: A systematic review of systematic reviews (an update). Implementation Science, 11(1), 1–12.

Saunders, M., Lewis, P., & Thornhill, A. (2012). Research methods for business students (6th ed.). London: Pearson.

Schwalbe, K. (2014). Information Technology Project Management (7th ed.). Boston, MA: Cengage Learning.

Schwalbe, K. (2016). Information Technology Project

Management (8th ed.). Boston, MA: Cengage Learning.

Simeon, R. & Murray, C. (2001). Multi-sphere governance in South Africa: An interim assessment. Publius, 31(4), 65–91.

South African Government. (2021). Provincial Government. South African Government [Online]. Available: https://www.gov.za/about-government/government-system/provincial-government [Accessed: 17 June 2021].

Stair, R. & Reynolds, G. (2018). Principles of Information Systems (13th ed.). Boston, MA: Cengage Learning.

Stranges, M., Ul Haq, S., & Dunn, D. (2014). Doing a Thematic Analysis: A Practical, Step-by-Step Guide for Learning and Teaching Scholars. IEEE Transactions on Industry Applications, 50(5), 3135–3140.

Trkman, P. (2010). The critical success factors of business process management. International Journal of Information Management, 30(a), 125–134.

Turner III, D. (2010). Qualitative Interview Design: A Practical Guide for Novice Investigators. International Journal of Information Management, 15(3), 754–760.

Valacich, J. & Schneider, C. (2018). Information Systems Today Managing in the Digital World (8th ed.). London: Pearson Education Limited.

Valdar, A. (2017). Understanding Telecommunications Networks (2nd ed.). London: The Institute of Engineering and Technology.

Walters, D. & Lancaster, G. (2000b). Implementing value strategy through the value chain. Management Decision, 38(3), 160–178.

Wei, K. & Loong, A. (2009). Measuring ERP system success: a respecification of the Delone and McLean's IS success model. Symposium on Progress in Information & Communication Technology 2009, 1(1), 7–12.

Wijayanto, H. (2020). Analysis Of Information System Success In The Colleges In East Java With Wijayanto ' s Approach Of Information System Success Model. Ekuilibrium: Jurnal Ilmiah Bidang Ilmu Ekonomi, 15(1), 70–82.

Yu, H., Abdullah, A., & Saat, R. (2014). Overcoming time and ethical constraints in the qualitative data collection process: A case of information literacy research. Journal of Librarianship and Information Science, 46(3), 243–257.

DOI: 10.6977/IJoSI.202212_7(4).0003
D. Lobov, M. Rybin / Int. J. Systematic Innovation, 7(4), 39-50(2022)

Openness to External Innovation in Major Oil and Gas Companies

Daniil Lobov[1], Mikhail Rybin[2]

[1] Department of International Issues in Fuel and Energy, International Institute of Energy Policy and Diplomacy, Moscow State Institute of International Relations under MFA of the Russian Federation, Moscow, Russian Federation

[2] Innovation Management Department, International Institute of Energy Policy and Diplomacy, Moscow State Institute of International Relations under MFA of the Russian Federation, Moscow, Russian Federation

Corresponding author E-mail: lobov.mgimo@mail.ru

(Received 22 July 2021; Final version received 14 January 2022; Accepted 24 May 2022)

Abstract

"Open Innovation" has proved to be a successful concept that can facilitate technological development of industries. Though the Open Innovation Model and the challenges of its implementation have been widely researched, there is a lack of studies that deal with the openness to external innovation in major oil and gas companies.

The objective of this research was to study major oil and gas companies' openness to external sources of innovation. The authors focused on the role of R&D investments in the R&D internationalization and the establishment of venture funds, the links between regional specificities, innovation portfolio diversity and the perception of external innovation. To do this, the authors examined the practices of 18 major oil and gas, oil service companies. The data was gathered from open digital sources and analyzed with the use of desk research, qualitative and quantitative methods, including regression and correlation analysis.

The study confirmed that major oil and gas companies with higher R&D investments and diverse innovation portfolios were more likely to be open to external innovation; regional specificities had a great impact on R&D networks as companies in North America and Western Europe had higher R&D internationalization ratio than in Russia and China. It was concluded that venture funding was an inclusive tool for expanding innovation funnel suitable for smaller companies with low R&D expenditures.

Keywords: Open Innovation Model; oil and gas industry; research and development; internationalization; globalization; innovation culture; venture capital funding.

1. Introduction

The digitalization today plays a major role in changing global business environment, becoming the basis for the Fourth Industrial Revolution. New technologies create opportunities for innovative companies and risks for those that cannot catch up with an accelerating pace of changes. The key to success in the new environment is to generate and implement knowledge. Intensification of innovation processes in oil and gas companies has also become more urgent: due to globalization and digitalization knowledge is a more accessible and important resource for creating added value (Salygin et al., 2019).

- Efficient knowledge management is of utmost importance to oil and gas companies as they are on the edge of changes of great magnitude created by environmental and political megatrends. While the Paris Agreement is shaping a new "cleaner" future of energy production, scientific breakthroughs are made in the key consumer market: transportation. Following the global trends, oil and gas companies from developed countries announce the energy transition strategy that requires considerable modifications in their business models.
- In order to increase the efficiency of innovation activities some companies apply the Open Innovation Model that relies on providing open access to innovation, facilitates open discussion, reduces the administrative costs related to protecting intellectual property and encourages the expanded use of external innovation sources (Naqshbandi and Kamel, 2017; Chesbrough and Bogers, 2014). Generally, that model is viewed as a reliable tool for improving the efficiency of innovation processes (Diener and Piller, 2010).

- The Open Innovation concept has been thoroughly researched. First it was introduced by Chesbrough in 2003. According to the list of innovation model generations (Rothwell, 1994) updated by Preez N. D., Louw L., Essmann H. (2009), the Open Innovation Model (OIM) is the latest, sixth generation of innovation models that is based on principles of collaboration between internal and external innovation sources. OIM has incorporated and replaced such models as «Technology Push», «Market Pull», «Network», etc. and it complies with current global Research and Development (R&D) trends and rapidly changing environment. Studies that focused on innovation models' generations did not address the system of relations between external and internal sources of innovation (innovation networks) in detail.
- Networks of internal and external innovation sources constitute the corporate innovation system. The concept of «corporate innovation system», is rather new and was first introduced in the year 2000 by O. Granstrand and later was expanded by E. Hartigh, B. Karlsson and G. O'Connor (2018). According to E. Hartigh, the corporate innovation system includes key elements that interact with each other and result in the implementation of innovation and innovative development. The elements include innovation actors and resources. The actors comprise teams, departments, business units, etc. responsible for the innovative development of a company.
- Growing globalization and internationalization of R&D activities was noted by Gassmann O. and Zedtwitz M. in 'New concepts and trends in international R&D organization' (1999). The article was written in the late 1990s and the results of the research confirmed an increasing role of independent overseas R&D centers in corporate innovative development. These foreign R&D centers facilitate the integration of technologies developed abroad. The authors grouped innovation networks by R&D facilities' location and authority.
- Ethnocentric centralized R&D (centralized research, all R&D activities are concentrated in the home country);
- Geocentric centralized R&D (centralized research, extra investments in R&D personnel in order to increase their international awareness);
- Polycentric decentralized R&D (decentralized federation of R&D sites with no supervising corporate R&D center);
- The R&D hub model (tight central control, the R&D center in the home location is the main laboratory for all internal and external R&D activities);
- Integrated R&D network (Domestic R&D is no longer the center of control for all R&D activities. Central R&D evolves into a competency center among many interdependent internal and external R&D units).
- In 1999 this topic was also brought up by Gerybadze A. and Reger G., who discussed the nature of innovation activities distribution in transnational corporations and developed a framework for analyzing different patterns of internationalization of R&D and innovation.
- The links between external and internal R&D sources of innovation were studied by Berchicci L. (2013). The author suggested that highly efficient innovation processes relied on the balance between internal and external activities in R&D networks. The similar conclusions were drawn by N. E. Hurtado-Torres, J. A. Aragon-Correa (2018) in the research dedicated to the effects of R&D internationalization on the innovative performance of energy companies.
- The connection between the implementation of venture capital and successful expansion of the innovation funnel in OIM was researched by Vrontis D., Rossi M., Thrassou A. (2013), (Rossi, 2015). Vishnevskiy K., Karasev O., Meissner D. (2015) researched the separation of functions between traditional R&D centers and venture funds according to the risk level. A significant number of studies touched upon several issues of venture capital implementation in energy sector, such as venture investments intensity, its positive impact on innovation activity, etc. (Kulanov et al., 2020; Pickl, 2019; Lerner, 2011; Moreva, 2018).
- Though there are numerous studies dedicated to the challenges that major oil and gas companies face when adopting the Open Innovation Model (Pellegrini et al., 2012; Ibrahimov, 2018) and regional factors that influence the internationalization of R&D activities (Gulbrandsen, 2008; Manshadi, 2017), there is a lack of new comparative studies that examine R&D internationalization ratio and the openness of oil and gas corporations from different regions towards external innovation in the current state of the global energy market.
- Moreover, the current research of the impact of venture capital on innovation in the majority of

cases is dedicated to the energy industry level and there is a room for the studies that will focus on the corporate level of the subject matter.

- The aim of this study was to research the openness of major oil and gas companies to external sources of innovation from the perspective of OIM using the data from global oil and gas companies. The hypothesis was that R&D expenditures and regional business culture have an important impact on the R&D model of major oil and gas companies that affect their openness to external innovation.
- "Openness" to external innovation included two aspects:
- Internationalization of R&D Networks. Companies with greater R&D investments were expected to have a greater share of foreign R&D facilities in their R&D networks;
- Implementation of venture funds as the tools to expand the external innovation funnel. Oil and gas companies with greater R&D investments were expected to have a higher chance of establishing venture funds.
- The authors suggested that the companies that were more open to external innovation were more likely to have a diverse innovation portfolio, as OIM was an effective tool to accumulate innovation from different technological fields.
- Furthermore, the authors touched upon the important issue of regional specificities that affected corporate R&D models and significantly impacted the penetration of open innovation in a company.
- Overall, this paper is aimed at presenting the contemporary research on the place of open innovation in research and development of major oil and gas companies in a systemized approach that organizes several aspects of the subject matter (previously discussed in academic literature separately) into one coherent view by answering the following questions:
- What companies are more likely to incorporate open innovation in their R&D models (the impact of regional business culture)?
- Which of approaches are companies more likely to implement according to their business scale (expenditures on overseas labs vs venture funding)?
- When do oil and gas companies implement open innovation model (the links between open innovation and innovation intensity)?

2. Research methodology

- The representative sample for this research was selected on the basis of annual revenue criterion using the cluster method. It included only major oil and gas, oilfield service companies with annual revenues exceeding 15 billion dollars. The revenue criterion was chosen in order to filter companies in accordance with their business scale, as the paper is dedicated to the research of major market players. Then the companies were filtered according to the data availability regarding the number of national and foreign research and development centers. A representative sample of 17 major oil and gas companies[1] from different regions of the world was formed. The inclusion of oilfield service companies (*) together with vertically integrated oil companies was justified by the convergence of their innovation development goals. The data on research facilities and venture funds was primarily found in open sources, including corporate websites and news publications (https://www.rig-zone.com/news/oil_gas/a/52886/halliburton_opens_technology_center_in_india/, http://www.sinopec.com/listco/En/about_sinopec/subsidiaries/research_institutions/, https://www.barco.com/ru/customer-stories/2012/q4/2012-11-26%20-%20new%20solutions%20at%20cenpes%20bring%20high%20tech%20to%20petrobras%20research%20centres etc.), annual reports were used to find information on revenues and venture funds (https://corporate.exxonmobil.com/Investors/Annual-Report, https://totalenergies.com/investors/publications-and-regulated-information/regulated-information/annual-financial-reports, https://www.gazprom.com/investors/disclosure/reports/2019/, etc.). The data was analyzed by the means of desk research, qualitative and quantitative methods of research.

[1] The sample did not include such major companies as British Petroleum due to the lack of data on their foreign and national R&D facilities.

- The authors compared the number of national and foreign R&D facilities of oil and gas corporations, the ratio was defined as the "internationalization ratio". It was hypothesized that companies with greater R&D internationalization ratio (more foreign R&D facilities per one national R&D center) had higher R&D expenditures. In order to prove the hypothesis, the authors conducted correlation and regression analysis with the following variables: X = R&D expenditures; Y = internationalization ratio; Y1 = number of foreign R&D facilities.

- To further prove the correlation between R&D internationalization and R&D investments, and to find out whether the share of R&D investments in corporate revenues (%) had any impact on the openness toward external innovation, the authors compared R&D networks and R&D strategies. R&D strategies were defined earlier in the previous study (Lobov, 2020). The companies were divided into nine groups from most active (1) to least active (9) according to two R&D investment metrics: total R&D investments (x) and the share of R&D investments in revenues (y, %) following Sturges' rule (Table 1).

Table 1 Groups of major oil and gas companies according to their R&D investments. Total R&D investments (bln $) and the share of R&D investments in revenues (Lobov, 2020).

Total R&D invest. (bln $) Share in revenues		1 0.96-0.80+	2 0.80-0.64	3 0.64-0.48	4 0.48-0.33	5 0.33-0.17	6 0.17-0
1	1.15%-0.97%+	1. Group CNCP (China)*, Sinopec (China)*		4. Group Suncor Energy (Canada)*,CNOOC (Chine)		7. Group Transneft (Russia), Occidental Petroleum (US) Equinor (Norway), Canadian Natural Resources (Canada)	
2	0.97%-0.78%						
3	0.78%-0.60%	2. Group ExxonMobil (US)*, Total S.A. (France.)*		5. Group Petrobras (Brazil), Rosneft (Russia)		8. Group Syncrude Canada (Canada)	
4	0.60%-0.42%						
5	0.42%-0.23%	3. Group R. D. Shell (Netherlands)		6. Group Chevron (US) Saudi Aramco (Saudi Arabia) BP (UK)		9. Group Gazprom (Russia), Lukoil (Russia), Repsol (Spain) ENI (Italy), ConocoPhillips (US), Indian Oil (India), Phillips 66 (US), Cenovus Energy (Canada), Transcanada (Canada)	
6	0.23%-0%						

- R&D Networks were identified according to the internationalization ratio and the division of competences between them. The authors generalized the list of R&D networks proposed by Gassmann O., von Zedtwitz M. (1999) and divided the companies in accordance with the new two groups (Table 2

Table 2 Types of R&D networks. Source: created by the authors based on (Gassmann and von Zedtwitz, 1999).

Network	Definition	Abbreviation
Geocentric R&D	One or several key R&D centers operate in one country. Low Internationalization ratio.	GRD
Distributed R&D	Several domestic and foreign R&D centers with equal distribution of authority. High Internationalization ratio. The Open Innovation Model.	DRD

- It was also hypothesized that companies with greater R&D investments were more likely to establish venture capital funds in order to expend the innovation funnel. As there was no sufficient quantitative data on oil and gas companies' venture investments, the dichotomous scale was used to assess the "venture capital indicator", 0 = a company did not implement venture funding, 1 = a company implemented venture funding.
- Next, the authors identified the companies' strategic innovation goals in order to assess the level of diversity of their innovation portfolios. It was suggested that companies with more diverse innovation portfolios were more open to external innovation. The authors chose several strategic innovation goals pursued by the major oil and gas companies and using the methods of desk research studied how many technological trends each company followed.
- Finally, drawing on the analysis of R&D networks, corporate experience in implementing venture funds and accelerators, the authors tried to assess the potential level of openness of oil and gas companies to external innovation. The average of Internationalization ratio and Venture capital indicator comprised the "Openness" indicator. Then the companies were divided into 3 clusters according to the openness indicator: "3rd" (high) level of openness, "2nd" (average) level of openness and the "1st" (low) level of openness to external innovation. Spearman correlation was used to confirm a relationship between the "level of innovation diversity" and the "openness to external innovation".

3. Results

- First no correlation was found between variables X = R&D expenditures and Y = internationalization ratio; Y1 = number of foreign R&D facilities. However, after excluding Russian and Chinese companies from the sample, the correlation became statistically significant.
- The correlation analysis validated that R&D internationalization ratio and thus the openness to external innovation in oil and gas companies depended heavily on R&D expenditures primarily in the Western European and North American oil and gas companies (notably, that list also included Saudi Aramco) (Table 3).
- (1. Variables: X = R&D expenditures; Y = internationalization ratio), R^2 = 0.759;
- (2. Variables: X = R&D expenditures; Y1 = number of foreign R&D facilities), R^2 = 0.771; Y1 = 0.007*X-0.852.
- The application of "revenue" variable gave the similar results to "R&D expenditures" variable which proves the direct impact of business scale on R&D intensity and internationalization.

- **Table 3 Number of foreign R&D facilities in oil and gas companies according to R&D investments, Source: created by the authors2.**

Company	Country	R&D expenditures (mln $), X	Internationalization ratio, Y	Foreign R&D facilities, Y1	National R&D facilities	Revenue (mln $) Z
Royal Dutch Shell	Netherlands	962	89%	8	1	352,106
Saudi Aramco	Saudi Arabia	573	75%	9	3	258,772
ExxonMobil	USA	1214	70%	7	3	255,583
Total S.A.	France	968	67%	4	2	176,249
Chevron	USA	500	0%	0	2	139,900
ENI	Italy	213	0%	0	6	79,566
Baker Hughes*	USA	700	80%	4	1	23,838
Equinor	Norway	300	33%	1	2	64,357
Repsol	Spain	88	0%	0	1	55,247

[2] Approx. number of R&D facilities according to open sources.

Halliburton*	USA	404	75%	3	1	22,408
Occidental Petroleum	USA	246	0%	0	2	20,393
Canadian Natural Resources	Canada	190	0%	0	1	18,504
Sinopec	*China*	*3061*	*11%*	*1*	*8*	*444,193*
CNPC	*China*	*3257*	*0%*	*0*	*10*	*415,000*
Gazprom	*Russia*	*197*	*0%*	*0*	*22 (1+)*[3]	*122,554*
Rosneft	*Russia*	*480*	*0%*	*0*	*29 (1+)*	*140,272*
Lukoil	*Russia*	*100*	*0%*	*0*	*5 (1+)*	*124,460*

- If a Western European or North American oil and gas company invested more than 300 mln dollars in R&D chances were high that it would open a research facility in another country in order to expand the innovation funnel. In contrast, while having high R&D expenditures, Sinopec had only 1 R&D facility abroad, CNPC, Gazprom and Rosneft had none.
- Using the regression equation that was acquired from the analysis of European and North American oil and gas companies, the authors calculated a notional number of foreign R&D facilities (Table 4) that could be created by the Russian and Chinese companies if they had internationalized their R&D networks and compared it to the actual number of foreign R&D facilities. According to the calculation, Gazprom, Rosneft, Sinopec and CNPC could open more foreign R&D facilities with their level of R&D investments.

Table 4 Actual and notional number of foreign R&D facilities in major Russian and Chinese oil and gas companies, Source: created by the authors.

Company	Actual № of foreign R&D facilities	Notional № of foreign R&D facilities[4]
Sinopec	1	21
CNPC	0	22
Gazprom	0	1
Rosneft	0	3
Lukoil	0	0

- Total R&D investments played the major role in determining the level of internationalization and openness to external innovation, while the share of R&D investments in corporate revenues did not (Table 5). Of the six companies that have implemented the distributed R&D network with high internationalization ratio, five companies belonged to the 1st – 4th group of total R&D investments (x, y). Previously mentioned companies CNPC and Sinopec did not follow this tendency. At the same time, the share of R&D investments in corporate revenues (%) did not affect neither internationalization nor R&D networks (x, y).

Table 5. Oil and gas companies' R&D networks by investment strategies. Source: created by the authors

Company	R&D network, internationalization ratio	R&D investment strategy
CNPC	*GRD* (0%)	1 (*1.2*) Active
Sinopec	*GRD* (11%)	1 (*1.2*) Active
Gazprom	GRD (0%)	9 (6.6) Passive

[3] National R&D facilities within major R&D centers of Gazprom, Rosneft, Lukoil. For example, 22 R&D facilities within "Gazprom VNIIGAZ"

[4] According to the regression equation Y1 = 0,007*X-0,852

Rosneft	GRD (0%)	5 (4.4)
Royal Dutch Shell	**DRD (89%)**	5 (**1**.5)
Saudi Aramco	**DRD (75%)**	6 (**3**.6)
ExxonMobil	**DRD (70%)**	2 (**1**.4) Active
Lukoil	GRD *(0%)*	9 (6.6) Passive
Total S.A.	**DRD (67%)**	2 (**1**.4) Active
Chevron	GRD *(0%)*	6 (4.5)
ENI	GRD *(0%)*	9 (6.6) Passive
Baker Hughes*	**DRD (80%)**	1 (**2**.2) Active
Equinor	DRD (33%)	7 (5.2)
Repsol	GRD *(0%)*	9 (6.5) Passive
Halliburton*	**DRD (75%)**	5 (**4**.4)
Occidental Petroleum	GRD *(0%)*	7 (5.1)
Canadian Natural Resources	GRD *(0%)*	7 (5.2)

No significant correlation was found between R&D investments and the number of venture funds (Table 6). It was confirmed that the practice of venture funding in oil and gas companies was not defined by the investments in R&D.

Table 6. Oil and gas companies sorted by R&D investments; established venture funds/ accelerators. Source: created by the authors.

Company	R&D Investments	Venture funds/ accelerators[5]
CNPC	3257	0
Sinopec	3061	0
ExxonMobil	1214	1
Total S.A.	968	1
Royal Dutch Shell	962	1
Baker Hughes*	700	1
Saudi Aramco	573	1
Chevron	500	1
Rosneft	480	1
Halliburton*	404	0
Equinor	300	1
Occidental Petroleum	246	1
ENI	213	0
Gazprom	197	1
Canadian Natural Resources	190	0
Lukoil	100	0
Repsol	88	1

- The authors analyzed open digital sources, annual reports, sustainability reports, etc. to identify innovation goals. Almost all companies set strategic goals to implement greener types of fuels, CO2 capture technologies, alternative energy, energy efficiency, digitalization and electric transport (Table 7).
- First, it was assumed that energy transition goals were only pursued by a half of the leading companies. However, due to the recent changing global perception of sustainable development, more companies implement them into long-term strategies. In March 2021 Chinese companies CNPC and Sinopec confirmed their commitment to achieving zero emissions by 2050 and developing hydrogen

1 – Venture funds are established. 0 – No experience in venture funding.

technologies (Evans, 2021, March 3; Xi Yihe, 2021, January 7)6.

Table 7
The number of oil and gas companies pursuing innovation goals. Source: created by the authors.

№	Innovation goals	Number of companies
1	Greener types of fuels	=16/17
2	CO2 Capture technologies	=17/17
3	Alternative energy	=16/17
4	Energy efficiency	=17/17
5	Digitalization	=17/17
6	Quantum computers	=5/17 CNPC. Royal Dutch Shell. ExxonMobil. Total S.A. ENI. Baker Hughes*
7	Electric transport and stations	=17/17
8	**Global energy transition**	=10/17

- Openness to external innovation depended on the level of total R&D investments. Companies with larger R&D investments had higher internationalization ratios, created distributed R&D Networks and had more diverse innovation portfolios; almost all of them established venture funds (Table 8). Companies with less than 500 mln dollars R&D investments were likely to have an "average" or "low" level of openness to external innovation. However, regional factor should also be considered as Chinese oil and gas companies' practice did not comply with the findings.
- Spearman correlation between innovation diversity "X" (corporate innovation goals/8 trends of innovation development) and openness to external innovation "Y" (from 1 (Low) to 3 (High) was found to be statistically significant (R^2 = 0.591) after the exclusion of Chinese oil and gas companies, which proved that overall, the companies that were more open to external innovation were more likely to have a diverse innovation portfolio.

Table 8
Oil and gas companies' openness to external innovation. Source: created by the authors.

№	Company	R&D Investments (mln $)	R&D Internationaliztion	Venture capital indicator	Innovation diversity	Openness to external innovation
1	CNPC	3257	0	0	1	0; Low (1)
2	Sinopec	3061	0.11	0	0.9	0.055; Low (1)
3	ExxonMobil	1214	0.70	1	1	0.85; High (3)
4	Total S.A.	968	0.80	1	1	0.835; High (3)
5	Royal Dutch Shell	962	0.89	1	1	0.945; High (3)
6	Baker Hughes*	700	0.67	1	0.9	0.90; High (3)
7	Saudi Aramco	573	0.75	1	0.8	0.875; High (3)
8	Chevron	500	0	1	0.9	0.5; Average (2)
9	Rosneft	480	0	1	0.8	0.5; Average (2)
10	Halliburton*	404	0.75	0	1	0.375; Average (2)
11	Equinor	300	0.33	1	0.9	0.665; High (3)
12	Occidental Petroleum	246	0	1	0.8	0.5; Average (2)
13	ENI	213	0	1	1	0.5; Average (2)
14	Gazprom	197	0	1	0.8	0.5; Average (2)
15	Canadian Natural Resources	190	0	0	0.7	0; Low (1)
16	Lukoil	100	0	0	0.7	0; Low (1)
17	Repsol	88	0	1	0.9	0.5; Average (2)

[6] It is worth noting that ConocoPhillips' leadership (the company is not included in the research) also confirmed the implementation of a more aggressive energy transition strategy due to the changing environmental policy in the US (Cocklin, 2021, February 2).

Discussion

- Major oil and gas corporations have higher chances of adopting the distributed R&D network and Open Innovation Model (OIM) due to several reasons. Firstly, DRD requires strong financial background and it is an expensive tool of innovation management; secondly, many leading corporations conduct operations across the globe and foreign R&D facilities function as centers for cooperation and representation; thirdly, market leaders might pursue aggressive innovation strategies that require active accumulation of innovative ideas. Smaller companies operate on a national scale, conduct R&D activities within one or several specialized R&D centers. Corporate R&D facilities abroad might serve as important acceptors of external innovation.
- Regional factors play an important role in shaping corporate innovation culture and subsequently the structure of R&D networks. While most major European and American oil and gas companies are open to external innovation, Chinese and Russian companies tend to conduct R&D within national laboratories and have a low internationalization ratio despite large business scale, considerable R&D investments and diversified portfolios.
- These results only partially confirm the conclusions presented by Gerybadze A. and Reger G. (1999), who claimed that national firms in smaller countries with strong innovation activities should develop home-country-based competence centers with less diversified innovation portfolios to gain competitive advantage in selected fields. It should be noted that in case of European and North American companies internationalization ratio and portfolio diversification are affected not only by regional factors, but primarily by the business scale of a company and the composition of R&D networks is based on "corporate-centered" rather than "region-centered" approach: national firms with home-centered R&D centers can be found in such major economies as the US and the internationalization of R&D activities can take place in any company with increasing revenues and R&D expenditures despite its location. Nevertheless, the regional factor does indeed impact the openness to external innovation. The low
- As the world goes through the global Energy transition, it may be hypothesized that the rapid changes in the perception of innovation abroad might produce "innovation culture spillovers" that will affect R&D internationalization level of major Russian and Chinese oil and gas companies confirms the influence of corporate culture on shaping R&D networks (Manshadi, 2017) and complies with the overall internationalization level of business activities (Lavrov and Aleksanyan, 2017).
- With the current Energy transition trend oil and gas companies are more likely to concentrate on sustainable solutions. Developing innovations in the new fields of production requires active knowledge accumulation and sharing as entering new markets and expanding business requires mastering new areas of science and knowledge, which motivates companies to increase the openness of their innovation systems and expand cooperation with external sources.
- There are new approaches to generating innovative ideas using the technological potential of other business organizations, such as venture capital funds and start-up scouting centers. Venture funds, accelerators and scouting groups expand the innovation funnel, helping to incorporate not only ideas, but also proven and ready-to-use solutions; they serve as alternative innovation hubs for external innovation sources.
- Regardless of their size and a region of operations, companies use venture capital funds and start-up accelerators, it might be concluded that those mechanisms of external innovation attraction are more inclusive in contrast to traditional foreign R&D offices. This hypothesis goes in line with the results of J. Lerner's research (2011) that confirmed the exceeding effectiveness of venture capital investments in innovation despite the fact that they accounted for a relatively small share of total research and development (R&D) expenditures.
- Though venture capital funding of oil and gas projects has a long and successful history in Europe and the US, Russian companies today are divided into those market leaders that have recently began to actively participate in venture capital to accelerate innovation (Gazprom 2019, Rosneft 2020) and those majors who has not (Lukoil, Surgutneftegaz, etc.). This time lag in the implementation of the best practices in Russia has been previously noted by Moreva E. in 2018. Russian companies in the long-term and subsequently increase the openness to external innovation, internationalization ratio, diversification of innovation portfolio, etc., yet the current deglobalization processes

(Schwab and Malleret, 2020) might negatively affect this scenario.

- Overall, it may be concluded that the openness to external innovation in oil and gas companies is based upon innovation culture and R&D investments. Companies from the regions that are less open to external innovation do not follow the common linear trend, according to which an increase in R&D investments leads to higher R&D internationalization ratio. Venture funding is the most flexible tool of innovation funnel expansion and a good alternative for the second-tier oil and gas companies to attract external innovation while maintaining low R&D expenditures.

4. Conclusion

- The Open Innovation Model is an effective tool that is used to increase the efficiency of knowledge management by promoting open discussion and access to innovation. Openness to external innovation is one of the aspects of OIM. The authors decided to research major oil and gas companies' openness to external sources of innovation by focusing on the role of R&D investments in the internationalization of R&D networks and the establishment of venture funds; analyzing the links between regional specificities, innovation portfolio diversity and the perception of external innovation.
- The study reveals that the openness to external innovation in major oil and gas companies depends on R&D expenditures. There is a strong correlation between the number of foreign R&D facilities, internationalization ratio and R&D investments. Oil and gas companies with smaller investments have a lower R&D internationalization ratio and they stick to one or several home-based R&D centers. Distributed internationalized R&D networks are an expensive tool for innovation funnel expansion.
- Regional specificities and innovation culture have a considerable impact on the openness to external innovation. North American and Western European oil and gas companies are more likely to have higher internationalization ratio than major Russian and Chinese oil and gas companies despite the comparable R&D investments and scale of operations.
- Oil and gas companies establish venture funds regardless of the volume of R&D investments and their business scale; therefore, it might be concluded that venture funding is a more inclusive tool for expanding innovation funnel than R&D network internationalization and it may be implemented by second-tier oil and gas companies while they maintain low R&D expenditures.
- The correlation between the level of innovation portfolio diversification and openness to external innovation may indicate that diverse innovation goals motivate companies to enter new fields of technology and subsequently expand the cooperation with external sources of innovation.

Declarations

Availability of data and materials: Data available within the article or its supplementary materials.

Competing interests: The authors declare that they have no conflicts of interest.

Funding: Grant funding was not used in this study

References

Berchicci, L. (2013). Towards an Open R&D System: Internal R&D Investment, External Knowledge Acquisition and Innovative Performance. Research Policy, 42(1), 117–127. https://doi.org/10.1016/j.respol.2012.04.017

Chesbrough, H. (2003). Open Innovation: The New Imperative for Creating and Profiting from Technology. Harvard MA: Harvard Business School Press.

Chesbrough, H. & Bogers, M. (2014). Explicating open innovation: Clarifying an emerging paradigm for understanding innovation. In H. Chesbrough, W. Vanhaverbeke, & J. West. (Eds.). New Frontiers in Open Innovation (pp. 3-28). Oxford: Oxford University Press.

Cocklin, J. (2021, February 2). ConocoPhillips Sees 'External Pressures' Mounting for Energy Indus-

try as Biden Presidency Begins. Natural Gas Intelligence. https://www.naturalgasintel.com/conocophillips-sees-external-pressures-mounting-for-energy-industry-as-biden-presidency-begins/

Diener, K. & Piller, F. T. (2010). The Market for Open Innovation Increasing the efficiency and effectiveness of the innovation process. Aachen: RWTH Aachen University, Technology and Innovation Management Group.

Evans, D. (2021). China's Sinopec is rolling out world's biggest hydrogen network. Energy voice. https://www.energyvoice.com/renewables-energy-transition/303892/chinas-sinopec-is-rolling-out-worlds-biggest-hydrogen-network/

Gassmann, O. & von Zedtwitz M. (1999). New concepts and trends in international R&D organization. Research Policy, 28(2-3), 231–250.

Gerybadze, A. & Reger, G. (1999). Globalisation of R&D: recent changes in the management of innovation in transnational corporations. Research Policy, 28(2-3), 251-274. https://doi.org/10.1016/S0048-7333(98)00111-5

Granstrand, O. (2000). Corporate innovation systems: a comparative study of multi-technology corporations in Japan, Sweden and the USA. Dynacom Series, Chalmers University of Technology, Gothenburg.

Gulbrandsen, M. (2008). Internationalisation of Industrial R&D. In Gornitzka Å., Langfeldt L. (Eds.). Borderless Knowledge. Higher Education Dynamics, vol 22. Dordrecht: Springer.

Hartigh, E. (2018). Company innovation system: a conceptualization. International Association for Management of Technology IAMOT 2018 Conference Proceedings (Birmingham, UK, 22-26 April, 2018).

Hurtado-Torres, N. E., Aragón-Correa, J. A., & Ortiz-de-Mandojana, N. (2018). How does R&D internationalization in multinational firms affect their innovative performance? The moderating role of international collaboration in the energy industry. International Business Review, 27(3), 514-527. https://doi.org/10.1016/j.ibusrev.2017.10.003

Ibrahimov, B. (2018). Open Innovation and application to Petroleum Industry. IFAC-PapersOnLine, 51(30), 697-702.

Kulanov, A., Issakhova, A., Koshkina, O., Issakhova, P., & Karshalova, A. (2020). Venture Financing and the Fuel and Energy Complex: Investing in Alternative Energy. International Journal of Energy Economics and Policy, 10(5), 531-538. https://doi.org/10.32479/ijeep.9963

Lavrov, S., & Aleksanyan, A. (2017). Case study: The Transnationalization of Russian Oil and Gas Companies. International Organisations Research Journal, 12(1), 209–228. https://doi.org/10.17323/1996-7845-2017-01-209

Lerner, J. (2011). Venture capital and innovation in energy. In Accelerating Innovation in Energy: Insights from Multiple Sectors (pp. 225-260). National Bureau of Economic Research, Inc.

Lobov, D. (2020). Otsenka Investitsionnoy I Patentnoy Aktivnosti Otechestvennykh I Zarubezhnykh Neftegazovykh, Neftekhimicheskikh Kompaniy V Ramkakh Realizatsii Energeticheskoy Strategii Rossiyskoy Federatsii Na Period Do 2035 Goda [Measuring oil and gas corporations' investment and patent activities according to the Energy Strategy 2035 of the Russian Federation]. Drukerovskij vestnik, 37(5), 137-150. https://doi.org/10.17213/2312-6469-2020-5-137-150

Manshadi, A. D. (2017). The Influence of Culture on Innovation in Multinational Organisations: Evidence from the Oil and Gas Industry. [Masters by Research thesis]. Queensland University of Technology. https://doi.org/10.5204/thesis.eprints.110705

Moreva, Eu. L. (2018). Venture Capital in Russia and the Global Evolution of Venture Capital. Journal of Reviews on Global Economics, 7, 843-850.

Naqshbandi, M. M. & Kamel, Y. (2017). Intervening role of realized absorptive capacity in organizational culture–open innovation relationship: Evidence from an emerging market. Journal of General Management, 42(3), 5-20. https://doi.org/10.1177%2F0306307016687984

Pellegrini, L., Lazzarotti, V., & Pizzurno, E. (2012). From outsourcing to Open Innovation: A case study in the oil industry. International Journal of Technology Intelligence and Planning, 8(2), 182-196. https://dx.doi.org/10.1504/IJTIP.2012.048476

Pickl, M. J. (2019). The renewable energy strategies of oil majors – From oil to energy? Energy Strategy Reviews, 26, 100370. https://doi.org/10.1016/j.esr.2019.100370

Preez, N. D., Louw, L., & Essmann, H. (2009). An Innovation Process Model for Improving Innovation Capability. https://www.semanticscholar.org/paper/An-Innovation-Process-Model-for-Improving-Preez-Louw/d85a97a149efad7d65ea1c7bdc4d7a6e2b8fdc19

Rossi, M. (2015). The role of venture capital funds in financing innovation in Italy. Constraints and challenges for innovative small firms. International Journal of Globalisation and Small Business, 7(2), 162-180.

Rothwell, R. (1994). Towards the fifth-generation innovation process. International Marketing Review, 11(1), 7-31. https://doi.org/10.1108/02651339410057491

Salygin, V. I. Guliyev, I. A., & Akieva, L. B. (2019). Vliyaniye tsifrovykh tekhnologiy na razvitiye mirovoy energetiki [The impact of digital technologies on the development of global energy]. Innovacii i Investicii, 5, 41-44.

Schwab, K., & Malleret, T. (2020). COVID-19: The Great Reset. Agentur Schweiz.

Xi Yihe. (2021, January 7). Chinese oil giant to spend $1.5bn a year on clean energy and reach net-zero by 2050. Recharge. https://www.rechargenews.com/transition/chinese-oil-giant-to-spend-1-5bn-a-year-on-clean-energy-and-reach-net-zero-by-2050/2-1-940717

Vishnevskiy, K., Karasev, O., & Meissner, D., (2015). Integrated roadmaps and corporate foresight as tools of innovation management: The case of Russian companies. Technological Forecasting and Social Change, 90(Part B), 433-443. https://doi.org/10.1016/j.techfore.2014.04.011

Vrontis, D., Rossi, M., & Thrassou, A. (2013). Open Innovation Systems and New Forms of Investment: Venture Capital's Role in Innovation. In D. Vrontis, & A. Thrassou (Eds.), Innovative Business Practices: Prevailing a Turbulent Era (pp. 168-194). Cambridge Scholars

DOI: 10.6977/IJoSI.202212_7(4).0004
C. Chen, H. Zhong / Int. J. Systematic Innovation, 7(4), 51-66 (2022)

TRIZ-based Study on Service Innovation of Certified Environmetal Education Facility

Chih-Hsien Chen[1*], Hei-Ting Zhong[2]
[1] Department of Management, Fo Guange University, Taiwan, ROC
[2] Luo-Dong Water Resource Recycling Center, Taiwan, ROC
*Corresponding author E-mail: chchen@gm.fgu.edu.tw
(Received 6 August 2022; Final version received 23 September 2022; Accepted 1 November 2022)

Abstract

The essence of environmental education is not only from understanding the environment to protecting the environment, from exploring methods to experiential learning, but also focusing on promoting outdoor teaching and eco-tourism. After the Environmental Protection Agency of the Executive Yuan issued the first environmental education site certification in 2011, it started the professionalization of environmental education and combined leisure tourism. Yilan County has been actively developing environmental education site certification and has achieved fruitful results. However, in recent years, it has encountered development difficulties or bottlenecks, resulting in the stagnation of the number of certified sites, which will affect the environmental education and tourism development in Yilan. These are the problems and motivations of this study. Therefore, this study establishes a service innovation framework for environmental education certification places by means of service quality and the characteristics of ecotourism. And through in-depth interviews, qualitative analysis and TRIZ methodology, the service innovation programs are developed. Finally, the second round of in-depth interviews was conducted with the personnel in charge of environmental education at the two environmental education certification sites in Yilan County to realize the service innovation schemes. The results showed that the four-stage empirical procedure identified four groups of technical conflicts and physical conflicts; and developed 11 innovative schemes through TRIZ's business-management conflict matrix, physical conflict, separation principle, system transfer analysis, and invention principles. Among them, eight innovative schemes have been realized at Field A, while four have been realized at Field B.

Keywords: Environmental education, TRIZ, Service quality, Ecotourism, Service innovation.

DOI: 10.6977/IJoSI.202212_7(4).0004
C. Chen, H. Zhong / Int. J. Systematic Innovation, 7(4), 51-66 (2022)

以 TRIZ 為基礎探討環境教育認證場所之服務創新

陳志賢[1]*，鍾惠婷[2]
[1]佛光大學 管理學系
[2]羅東地區水資源回收中心
*通訊作者 E-mail：chchen@gm.fgu.edu.tw
(Received 6 August 2022; Final version received 23 September 2022; Accepted 1 November 2022)

摘要

環境教育的本質除了從認識環境到保護環境、從探索方式到體驗學習之外，也著重於推展戶外教學和生態旅遊。行政院環保署於 2011 年頒發了第一處的環境教育場所認證之後，開啟了環境教育之專業化並結合了國人的休閒旅遊。宜蘭縣過去積極發展環境教育場所認證且成果豐富，但近年來遭遇發展困難或瓶頸，以致認證場所數量成長停滯，將影響宜蘭之環境教育與觀光發展，此為本研究之場域問題與動機。因此，本研究藉由服務品質與生態旅遊之特性，建立環境教育認證場所之服務創新架構。並透過深入訪談、質性分析與 TRIZ 方法論，發展服務創新方案。最後則針對宜蘭縣二處環境教育認證場所的環教負責人員，進行第二回合的深入訪談，來探討服務創新方案之實踐。結果顯示，四階段的實證程序辨識出四組的技術衝突與物理衝突；並透過 TRIZ 的商管矛盾矩陣、物理衝突、分離原則、系統轉移、發明原則，發展出 11 個創新方案。實證結果，A 場域在八個創新方案獲得實踐，而 B 場域則在四個創新方案獲得實踐。

*關鍵詞：*環境教育，TRIZ，服務品質，生態旅遊，服務創新。

1. 前言

1972 年的聯合國人類環境會議 (UNConference on the Human and Environment)發表人類宣言使人類注意環境的問題，起始了人類與自然環境良性互動的新紀元。同年於瑞典的斯德哥爾摩召開人類環境會議(United Nations Conference on the Human Environment)中，提出發展環境教育是解決世界環境問題的最佳工具之一。自此之後，聯合國教科文組織開始在國際間召開會議定環境教育之實施作法(Palmer, 1998；張子超，2001)。

在 1975 年的 Belgrade Chart 中，提及環境教育的目的在於使人類認識、關切環境及其相關問題，從個人及團體出發，致力於當前環境問題的解決並預防未來新問題的發生(楊冠政，1993)。而台灣早期的環境教育著重在於推展戶外教學或是田野教育。近年來，人們對於環境的思考，不只是關注自然環境，還包含了人文環境、歷史傳統及社會生活。因此，在推動環境教育時，必須以所有的教育皆是環境教育的基本理念；不只重視課程整體規劃，更強調永續發展的概念(王鑫，1999；郭實渝，1999)。

因此，環境教育是一種透過探索、觀察、體驗及學習的方式，從認識、瞭解並關切當前的環境問題與環境關係。促使人們具備知覺能力，以保護和改善環境問題與環境關係。進而致力於維護生態平衡及環境品質，以達到環境永續的目標；並且，藉由建立環境倫理，將之擴及生態旅遊之遊客認同，來一起推動環境教育。

台灣在推動環境教育立法方面，1987 年 10 月頒佈了環境保護政策綱領，1992 年環保署於環境保護五年中程施政目標計畫中明列推動制定環境教育法。2010 年 6 月 5 日環境教育法頒布實施，並將 6 月 5 日訂為地球環境日，深具重大環境教育里程碑意義。有關環境教育之沿革與發展情形，詳如表 1 所示。

根據國內之環境基本法第 2 條對環境的定義，係指影響人類生存與發展之各種天然資源及經過人為影響之自然因素總稱，包括陽光、空氣、水、土壤、陸地、礦產、森林、野生生物、景觀及遊憩、社會經濟、文化、人文史蹟、自然遺蹟及自然生態。另依環境教育法第 3 條的定義，環境教育係指運用教育方法，培育國民瞭解與環境之倫理關係，增進國民保護環境之知識、技能、態度及價值觀，促使國民重視環境，採取行動，以達永續發展之公民教育過程。故環境教育的範圍則包含了各級學校或社教機構的環境教育和戶外環境教育。同時，制定環境教育法的目的在於促進國民瞭解個人們與環

境的相互依存關係，增進全民環境倫理與責任，進而維護環境生態平衡、尊重生命、促進社會正義，培養環境公民與環境學習社群，以達到永續發展(環保署，2022)。

表 1 台灣之環境教育沿革與發展

時間	里程碑
1987	行政院頒佈環境政策綱領。
1992	行政院制定環境保護中程施政目標。
2002	擬訂環境教育法草案。
2010	環保署頒佈環境教育法。
2011	環保署頒發第一處環境教育場所認證。
2013	行政院會通過將成立環境資源部。
2015	推動聯合國「2030 永續發展目標」(SDGs)。
2018	教育部與美國環保署合作推動教育部環境教育青年國際領袖營計畫。
2019	首次辦理學校環境教育實作競賽，展現環境學習行動能力。
2022	行政院會通過組織調整草案，將現有環境保護署改制為環境部。

資料來源：整理自環保署與 2018 年環境白皮書

另外，環境教育法第 19 條規定，全國各機關、公營事業機構、高級中等以下學校及政府捐助基金累計超過百分之五十之財團法人，每年都要安排所有員工、教師、學生參加 4 小時以上的環境教育課程。此條文結合了學校的校內教育和校外的參訪、休閒或旅遊來達成環境教育之目的，而環境教育認證場所正是連結這兩種系統的最佳橋梁(周儒，2000)。並且，政府近年來積極振興觀光和休閒旅遊，使民眾對於假日的休閒旅遊的需求增加，促使民眾對於結合環境教育和體驗大自然的生態之旅需求與日俱增(交通部觀光局，2022)。

依據環境教育設施場所認證及管理辦法，設置環境教育場所的目的在於建立及提供完整環境教育專業服務、資訊與生態旅遊之資源。截至 2022 年 7 月為止，通過環保署之環境教育設施場所認證共有 229 處，各縣市之分佈與數量詳如表 2 所示(環保署，2022)。這些環境教育認證場域，除了可協助地方教學，對於地方觀光性也帶來助益。然而，在 2016 年時，通過環境教育設施場所認證只有 140 處，也就是這五年多來增加約 63%之多，但宜蘭縣只增加了一處。另外，在 2016 年時，宜蘭縣通過環境教育設施場所認證總數居第四(共計 11 處)，僅次於臺北市和高雄市的 13 處、新北市的 12 處；但 2022 年時退居第七，但總數仍為六都以外的第一名。可見宜蘭縣過去積極發展環境教育場所且成果豐富，但近年來可能遭遇發展困難或瓶頸，以致認證場所數量成長停滯，將影響宜蘭之環境教育與觀光發展，此為本研究之場域問題與動機。

表 2 各縣市通過環保署認證環境教育場所一覽表

縣市別	場所	縣市別	場所
1.基隆市	3	12.嘉義縣	8
2.臺北市	20	13.嘉義市	2
3.新北市	18	14.臺南市	19
4.桃園市	31	15.高雄市	18
5.新竹市	4	16.屏東縣	8
6.新竹縣	7	17.澎湖縣	2
7.苗栗縣	10	18.宜蘭縣	12
8.臺中市	22	19.花蓮縣	7
9.彰化縣	7	20.臺東縣	6
10.雲林縣	10	21.金門縣	4
11.南投縣	10	22.連江縣	1
合計	229		

資料來源:行政院環保署 2022

在環境教育之相關研究方面，國內學者在過去 20 年來大都偏向於探討環境教育的個案或經驗，例如新竹芎林的自然谷(羅雅怡，2017)、嘉義東石的鰲鼓濕地(朱珊玟&吳連賞，2022)、新北貢寮的水梯田(薛博聞&方韻如，2015)、台北市的植物園(黃聖茹等人，2018)、基隆的獅球嶺步道(李佩真等人，2020)。次之，則為研究各級學校在環境教育的作法分析或實施成效(晏涵文等人，2006；陳敬能&洪甄憶，2011；張子超，2019；林明瑞&張廷鋐，2021)。另外，亦有不少文獻探討台灣的環境教育發展或內涵(許芳諭，2006；徐筱琦，2015；高翠霞&張子超，2016)，以及環境教育的認證或導覽解說(吳鈴筑&王鴻濬，2012；林明瑞&李春蓮，2020；莊潔&高翠霞，2021)。

雖然近年來已增加一些文獻探討環境教育的其它議題，包括了環境教育場域與生態旅遊之結合(歐陽宇等人，2017；蘇金柱人，2021)、環境教育導入之新興科技(郭晴之&荊溪昱，2016 王照明&郭書伶，2017)，以及環境教育場域之服務品質(劉惠國&何月妃，2016；劉惠國等人，2016)。但以探討環境教育的創新服務為議題的研究依舊有限(羅玉青，2015)。劉源隆等人(2021)針對台電公司為透過環境教育以推動企業社會責任，結合了桌遊與擴增實境體驗之創新進行研究，但攸關創新服務之工具與系統性之創新程序則尚未進行充分之探討。因此，本研究之目的即為透過系統性之創新程序與工具，結合生態旅遊與服務品質，為環境教育場所發展創新服務；並為

宜蘭近年來在環境教育之認證場所所遭遇的發展困境，提供重要的參考。

2. 文獻探討

2.1. 環境教育

氣候變遷不僅攸關人類的生存環境，也逐漸與商業之發展密不可分；因此，近年來興起一連串的環境關懷新浪潮，從企業社會責任(CSR)到大學社會責任(USR)，從聯合國的永續發展目標(SDGs)到環境社會治理(Environmental Social Governance, ESG)。其中，在教育部的 USR 推動中心辦公室，對全國各大學校院提出了第三期的 USR 實踐計畫，期程包括 2023 到 2024 年。該 USR 實踐計畫明訂了各大學校院欲申請 USR 計畫時，必須增加該計畫之提案議題和 SDGs 的對應項目，至少應對應 1 至 5 個項目(教育部 USR 推動中心，2022)。

ESG 是環境保護、社會責任與公司治理的縮寫。ESG 不僅只是社會參與或社區關懷或是企業慈善，更是追求企業的永續經營；因為，它整合了財務報表、環境責任和永續經營的指標和操作策略，評估企業的穩健、健全與永續。在環境保護方面，ESG 包含了環境污染防治與控制；在社會責任方面，ESG 包括了勞工的工作條件、工作安全、與受產業影響之利害關係人。對企業而言，積極推動 ESG 議題，將可能為企業經營的聲譽與訂單帶來正面效益。就如同過去企業重視 CSR 和 SDGs 對於企業的影響，同樣也可能具有正面的加分作用。未來，愈來愈多的國外企業將以 ESG 作為企業往來之評估條件，要求合作企業必須具備 ESG 之施行與管理；因此，ESG 將可能成為企業訂單的基本要求。對投資人而言，愈重視 ESG 的企業，可能擁有較透明的財報，以及相對低風險的營運狀況，有利於企業長期的永續經營(劉宗聖等人，2019)。

環境教育是一種全面性與整合性的終身的學習過程，關切人和外在環境系統之間交互的連結性和互動性(王順美，2004)。依據 Palmer (1998)對環境教育的闡述，它包含三大要素，分別為：1.有關環境的，2.在環境中學習的，3.促進環境關懷的。環境教育在有關環境的本質上，藉由體驗，可以讓人在環境中衍生出學習、發現和知識的探索。在促進環境關懷的認知上，除了藉由環境教育來促使人們持續的關注環境之外；也透過實際的行動，提供人們在環境中學習的場所。也就是說，環境教育把環境作為學習的媒介來整合這三大要素，透過擴展經驗、促進行動、發展關懷的學習過程，促進人們形成關懷環境的觀念、態度與行動(楊冠政，1997)。以戶外教學的角度，他們認為環境教育是為了天然資源的妥善利用，其重點是在教育大眾關注土地、水、森林、野生動物資源的價值及其妥善的管理和運用。

David & Dennis (2006)則以環境教育課程規劃的角度認為，環境教育包含三項要素，分別為 1.運用教育方法，培育國民瞭解與環境的倫理關係。2.增進國民保護環境的知識、技能、態度以及價值觀。3.促使國民重視環境，採取行動，以達永續發展的公民教育過程。許世璋與任孟淵(2014)提及，大學階段的環境教育對於環境公民的培養呈現出關鍵性的影響。該研究建立了一個具有整合大學環境教育課程之理性、情感與終極關懷等三個面向的學習模式，以培育環境公民之行動力。因此，大學之環境教育的學習除了理性思辨之外，亦應包括情感的涉入與信念的建構，使整體環境教育的學習過程包含理性、情感與關懷面向。

Rahman 等人(2018)針對馬來西亞的 12 所個小學和中學研究有關於環境教育教學所面臨的挑戰。該研究透過半結構化深入訪談來蒐集教師的資料。研究結果顯示，實施環境教育的兩個挑戰分別為教師面和學生面，教師面臨的挑戰是受到時間限制、繁重的工作量、教具/手冊的可用性，以及缺乏學校管理者的支持，學生面臨的挑戰是來自他們的缺乏環境意識、衛生問題、缺乏自信和學習中的問題。

2.2. 環境教育與生態旅遊

生態旅遊 (Ecotourism) 或是生態性旅遊 (Ecological tourism)的概念，是在對當地文化與環境最小的衝擊下，提供遊客滿足感，並給當地帶來經濟效益。Karagiannis & Polo(2011)認為，生態旅遊是尋求永續觀光發展的一種方式。隨著觀光旅遊對來環境的汙染、破壞與社會衝擊，永續觀光發展，是鼓勵遊客和在地利害關係人主動參與並引導大家一起來保護在地的環境。

聯合國於 2002 年宣布為「國際生態旅遊年」，由聯合國環境規劃署及世界觀光組織(World Tourism Organization, WTO)共同推動生態旅遊模式，獲得了全世界廣大的響應。行政院觀光發展推動小組及交通部為了落實國內旅遊發展方案、配合聯合國發布的國際生態旅遊年及亞太經濟合作(APEC)會議共同發布之觀光憲章，宣布 2002 年為台灣生態旅

遊年，並推動生態旅遊計畫。(交通部觀光局，2002)。

觀光局之生態旅遊計畫共有六項策略，30 餘項措施，包括研訂生態旅遊白皮書、研訂生態旅遊規範、訂定自然人文生態專業導覽人員管理辦法、辦理生態旅遊教育訓練、推廣宣傳活動，同時篩選 40 條生態旅程。為了推廣國內生態體驗，觀光局也規劃推動一系列生態體驗觀光主題，分別為生態旅遊年、海灣旅遊年、小鎮漫遊及脊樑山脈生態旅遊年，並舉行 2017 生態旅遊年啟動記者會(交通部觀光局，2017)。

Weaver & Lawton (2007)回顧近 20 年來的生態旅遊文獻指出，大多數的研究聚焦於市場區隔、野生動植物的生態衝擊與社區觀點的生態之旅。然而，對於環境教育和生態旅遊的品質管控和外部環境的關注顯然較少。Khursheed 等人(2011)提及，Hetzer 在 1965 年即提出生態旅遊的四個準則，包括：對當地文化及環境產生最小的衝擊、利用草根性的資源或文化產生最大的經濟效益、對旅遊當地產生最小及最大的期望，以及提供參與的遊客最大的滿足。Holden & Fennell (2012)亦指出生態旅遊具有五項原則，分別為 1.以自然為導向(Nature-based)，2.生態資源永續利用(Ecologically sustainable)，3.環境教育(Environmentally educative)，4.當地受惠(Locally beneficial)，5.觀光客滿意(Tourist satisfaction)。

黃志成等人(2004)以日月潭國家風景區為研究對象，探討生態旅遊之承載量影響因素。該文研究結果顯示，影響日月潭國家風景區生態旅遊承載量之前四項因素分別為廢水排放、外來優勢物種的引進、當地居民環境保護意識及居民的容忍度。江昱仁等人(2008)藉由生態旅遊進行學生對環境教育的認知、環境態度、環境行為的調查，該文之結果顯示生態旅遊能增加學生對環境教育的認知深度與認知廣度，達到認知層面的轉變。許多學者均說明生態旅遊包含了環境教育的成分，並應將學校的戶外教學融入生態旅遊和環境教育的議題之中(王鑫，2002；吳忠宏等人，2007)。

綜合以上學者對於生態旅遊的研究，得知生態旅遊應以自然環境的教育為基礎，透過解說、遊憩與環境保護規劃，將觀光衝擊降至最低，以達到愛護環境態度與生態資源永續利用的旅遊方式。

2.3. 環境教育與服務品質

在服務品質的構面發展方面，1980 年代可以說是學術理論的密集時間帶，包括了 Sasser 等人在 1978 年將服務品質區分為七個構面，分別為：1.安全性，2.一致性，3.態度，4.完整性，5.調節性，6.即用性，和 7.及時性。1980 年 Rosander 則以人員績效品質、設備績效的品質、資料的品質、決策的品質、產品的品質五項來衡量服務品質。Quinn & Rohrbaugh (1981)將服務品質依序分為三個構面，分別為 1.投入：包括實體的設施與人員，2.過程：服務提供者與顧客的互動過程，3.結果：顧客是否得到其所要求之利益。1982 年，Lehtinen 認為服務品質是決定於實體品質、公司品質，和互動品質等三個構面。Christion & Gronroos 則提出六項構面來評估服務品質，分別為 1.專業技能，2.行為態度，3.可行性及彈性，4.信賴性，5.應變能力，6.名聲及信用(鍾惠婷、陳志賢，2017)。

Garvin (1984)另以五種觀點來定義品質，分別為 1.超越的觀點(Transcendent approach)，2.產品的觀點(Product-based approach)，3.使用者的觀點(User-based approach)，4.製造的觀點(Manufacturing-based approach)，5.價值的觀點(Value-based approach)。Parasuraman, Zeithaml & Berry(1985)認為，服務品質是在傳遞過程與服務提供者和消費者互動過程中所產生的服務優劣程度，並以使用者認定的角度來定義服務品質；因此，將服務品質區分為十個構面，分別為：1.有形性(Tangibles)，2.可靠性(Reliability)，3.反應性(Responsiveness)，4.勝任性(Competence)，5.禮貌性(Courtesy)，6.信用性(Credibility)，7.安全感(Security)，8.接近性(Access)，9.溝通性(Communication)，和 10.理解性(Understanding)。

Juran 認為服務品質的定義為企業是否能夠滿足顧客的需求；故提出五項構面來衡理服務品質，分別為內部品質、硬體品質、軟體品質、及時反應、心理品質。因此，服務品質是決定於消費者主觀的判斷，重點為合乎消費者的需求，並非合乎服務供應者的標準或規格(Garvin, 1987)。另外，他也提出八個構面來衡理服務品質，分別為：執行、特色、可信度、符合規格、持續性、服務能力、外觀、知覺品質。Bitner (1990)則認為服務品質是一種顧客對服務消費之後，是否再次購買該服務的整體態度。於是，Parasuraman, Zeithaml & Berry(1988)提出了服務品質的 SERVQUAL 模型或稱服務品質落差模式(Gap model of service quality)，以顧客對服務的期望與實際知覺的差異程度來衡量服務品質。故發展出現今廣為應用的

五個衡量構面，分別為有形性、可靠性、反應性、保證性及關懷性構面。

在環境教育之服務品質方面，吳鈴筑與王鴻濬(2012) 以遊客的角度，調查國家森林遊樂區服務品質要素，該文之結果顯示環境教育設施場所認證為我國環境教育推動之重要工作項目，藉由通過認證的設施場所，提供國人優質的環境教育服務，將可確保環境教育之品質。

而生態旅遊可藉由導覽解說，引導遊客體驗當地自然、人文，尋求旅遊的永續發展。遊客對生態旅遊服務品質認知較高的二個項目依序為戶外活動之安全裝備和活動有吸引力；並且，建議在舉辦生態旅遊時應注重場地清潔、解說風趣與生態環保的品質(劉惠珍等人，2013)。姚映阡與湯幸芬(2016)以銀髮族遊客的觀點，探討生態旅遊地服務品質與體驗滿意度。結果顯示，生態旅遊地服務品質構面中，以服務人員滿意程度較高，包括園區服務人員的態度、即時回應遊客需求與具備專業知識等服務品質屬性。

李晶等人(2013)以遊客的角度，藉由二維品質模式探討國家森林遊樂區生態旅遊地之服務品質。結果顯示，各森林遊樂區應視生態旅遊地所具備之特質而發展，其中，環境教育之解說則應提供相對應的環境教育設施以提昇服務品質。因此，本研究即參考 SERVQUAL 模型之理論來探討環境教育認證場所之創新服務，來建立深入訪談之服務品質構面問卷。

2.4. 環境教育與創新服務

TRIZ 是由前蘇聯海軍專利審查員 Altshuller 領導的機構和研究團體，藉由分析與歸納專利產品之特性，發展出解決創新問題的思維模式和過程。TRIZ 是由俄文的縮寫得來，英文或可縮寫為 TIPS (Theory of Inventive Problem Solving)，中文翻譯為萃思或萃智或是創造性問題解決理論。Altshuller 根據五個難易度和創造力將它分為五種的創新層級，通常在創新層級 1 並未加入創新元素，而創新層級 2 至 5 級之困難程級越高且慢慢有運用 TRIZ 之創新元素(Gadd, 2011)。

TRIZ 具有五個分析系統性創新問題的支柱，分別為資源、功能、矛盾、理想性，以及時間暨空間的介面。分析邏輯、以知識為基礎的理念，以及系統的思維方法，是 TRIZ 分析問題的三個基礎(Souchkov, 1997)。傳統的 TRIZ 應用領域主要著重在技術和工程上的問題；然而，近年來，TRIZ 也廣泛被運用至商業和管理等非工程問題的領域(Savransky, 2000; Leon, 2010)。Mann (2004)將傳統的 TRIZ 應用到商管領域時，將系統性創新問題的支柱增加為七個，分別為理想性、循環性、資源、緊急性、功能、衝突，以及時間暨空間的介面。

Chai 等人(2005)提及，過去對創新服務是難以預測其有效性，所以該文提出一個以 TRIZ 為基礎之創新架構，將可克服這個困難。該文並以這個 TRIZ 服務設計模型來發展創新服務，並驗證了二個創新服務設計個案的有效性，個案一是新加坡聖陶沙島的觀光計畫，個案二是新加坡大學食堂的服務作業再造。陳偉星(2015)應用 TRIZ 來探討人力資源情境下之衝突分析，並以一家保險經紀公司和另一家通信產品生產暨提供服務的公司作為實證之個案。該文之研究結果建立了四個構面，共計 19 項的人力資源之管理參數，並歸納了 40 發明原則逐一在人力資源管理的行動意涵，以供後續研究者之參考。林永禎等人(2018)應用商管 TRIZ 方法發展便利商店之創新管理方案。該文先藉由問卷調查分析便利商店需改進的服務品質項目與其重要的服務品質問題，再針對這些重要的服務品質問題來進行矛盾分析，以發展創新方案，最後其實證之結果顯示，解決這些矛盾可獲得 14 個創新的管理方案。

近年來，很多的研究應用 TRIZ 在非傳統性的工程領域來發展創新的理論內容，進而各自發展出不同服務業種的矛盾矩陣參數和 40 項發明原則。其中，與本研究比較相關的研究成果，包括 Chan & Chen (2003)認為生態是需要很多的創新靈感，該文提出了 40 項生態創新的實例，逐一配適 TRIZ 的 40 發明原則，內容包含了生態和環保方面的創新產品和流程。Retseptor (2003)針對品質管理分析一些實例與案件，將典型的 40 項發明原則延伸至品質管理之領域裡。這些實證的例子包括了品質標準、品質管制、品質保證、可靠度、顧客焦點、供應商選擇、專案管理與改善團隊等等。另外，Retseptor 於 2005 年再度針對行銷領域之市場、銷售與廣告，延伸了典型的 40 項發明原則之應用實例。

在教育方面，Mash 等人則應用了 Mann 的商管矛盾矩陣 31 個參數，帶領其 12 位博士研究生團隊，重新定義和配適了 40 項發明原則與實例。這些 40 項發明原則的實例則分別區分為管理和課程教學二類(Mash 等人，2002; Mash, 2004)。而後陸續也有學者再針對其它相關領域發展出 40 項發明原則之應用實例和有關於參數或是矛盾矩陣的修改。

3. 方法論

基於近年來愈來愈多文獻探討環境教育與生態旅遊之結合，以及環境教育場域之服務品質。並且，思索環境教育場所之創新服務，以突破宜蘭近年來在環境教育之認證場所所遭遇的發展困境。因此，本研究整合服務品質與生態旅遊之理論，設計半結構式之深入訪談問卷，藉由質性分析與 TRIZ 工具，發展環境教育場所之創新服務，研究架構如圖 1 所示。

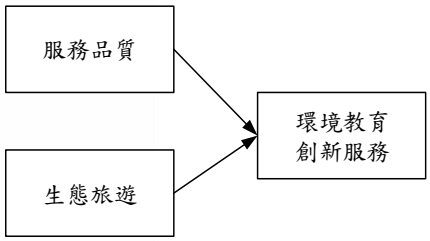

圖 1 研究架構圖

在生態旅遊之理論參考方面，Hetzer (1965)將生態旅遊界定為五項構面，分別為 1.文化(Culture)，2.環境(Environment)，3.生態旅遊(Ecotourism)，4.經濟(Economic)，5.教育(Education)等構面。Ross & Wall (1999)則以四個構面來探討生態旅遊，分別為 1.當地社區(Local Communities)，2.旅遊(Tourism)，3.生物多樣性(Biological diversity)，4.管理政策(Management Policy)。Stone & Stone (2011)則以當地社區(Local communities)、公園資源(Park recourses)、旅遊(Tourism)與管理政策(Management policy)四項因素來探討生態旅遊之內涵。而 Weaver & Lawton (2007)則認為生態旅遊強調旅遊地體驗，其管理層面應結合生態面(Ecological)、社會文化面(Socio-cultural)、經濟面(Economic)、品質面(Quality control)，和倫理面(Ethics)。故本研究在生態旅遊變數包括社會面、旅遊面、經濟面、教育面、環保面，以及管理面。

另外，在服務品質方面，本研究參考 Parasuraman, Zeithaml, & Berry (1988)提出的 SERVQUAL 模型來探討環境教育，並以可靠性和保證性來建立深入訪談問卷。因此，綜合以上的服務品質與生態旅遊變數，本研究設計了八個構面，作為探討環境教育認證場所發展創新服務之深入訪談問卷。表 3 顯示八個構面之問卷內容與操作型定義，分別為服務品質的保證性和可靠性構面，以及生態旅遊的社會面、環保面、經濟面、旅遊面、教育面和經營管理面。

表 3 深入訪談問卷內容與操作型定義

構面	問卷題目	參考文獻
保證性	1.環教人員如何獲取專業知識?	Parasuraman, Zeithaml & Berry (1988)
可靠性	2.服務人員面對不同的遊客屬性或遊客需求時，有何不同的接待方式?	Parasuraman, Zeithaml & Berry (1988)
社會	3.經營方式如何兼顧自然保育與遊憩需求?(例如:垃圾、噪音或污染...)	Weaver & Lawton (2007)
環保	4.請談談最想教育遊客的環境(或保育)知識有那些？	Hetzer(1965) ; Ross & Wall (1999)
經濟	5.請談談環教帶來(或增加)多少的經濟收入或旅客人次？	Hetzer (1965);Weaver & Lawton (2007) ; Ross & Wall (1999)
旅遊	6.請談談環教將帶給遊客那些休閒(或娛樂)效果?	Hetzer (1965); Ross & Wall (1999); Weaver & Lawton (2007)
教育	7.如何結合社區和文化的保存？	Hetzer(1965); Weaver & Lawton (2007); Ross & Wall (1999)
經營管理	8.請談談主要的環教設施及未來的規劃?	Ross & Wall (1999); Stone & Wall(2003)
	9.請談談曾經遭遇的經營困境有那些?	Ross & Wall (1999); Stone & Wall(2003)
	10.請談談未來有關環教作法有何不同的規劃?	Ross & Wall (1999); Stone & Wall(2003)

本研採用質性研究蒐集資料之常用方法：深度訪談法。質性研究是研究者對於某事件或現象，進行一系列系統性的觀察與記錄，分析觀察所得的資料，最後透過歸納法獲得研究結果的一種研究方式。Patton (1999)認為，透過訪談來蒐集資料有三種方法，分別為：1.非正式的會談(Informal conversational interview)；2.半結構式訪談(Semi-structured in-depthinterview)；3.標準化開放式訪談(Standardized open-ended interview)。

半結構式訪談是介於結構式訪談與無結構式訪談之間的一種資料蒐集方式。在訪談前，研究者必須根據研究的問題與理論，設計訪談問卷，作為訪

談內容與方向；訪談進行中，在徵詢受訪者之同意後進行錄音，並根據訪談時的具體情況，對訪談問題與內容作彈性的調整，故時常會有可能蒐集到研究者事先沒有想到的問題(胡幼慧，1996)。故本研究透過文獻回顧，設計深度訪談之半結構式問卷，以強化訪談問卷之內容效度。而後透過錄音檔和逐字稿之編碼，再藉由 Nvivo 軟體進行節點分析。

在創新之發展方面，產品的改良受限於優化的取捨，無法解決技術性或是物理性的矛盾問題，使得產品的改善效果受到限制。Altshuller 提出的 TRIZ 方法論，關注於五個創新的核心問題：資源、功能、矛盾、理想性、時間暨空間的介面。故本研究採用以矛盾為基礎的 TRIZ 系統性創新方法論。

TRIZ 有別於傳統的優化方法，它強調發明或創新可依一定的程序與步驟進行，而非腦力激盪或嘗試錯誤法。TRIZ 的解題程序上，首先是對於問題狀態進行定義分析，將特定問題轉化成問題類型；之後，再選擇 TRIZ 的解題工具(例如矛盾矩陣、發明原則、分離原則、趨勢演進與標準解等)，尋找觸發解。最終，則藉由理想性來評估其效益。Mann (2004)將 TRIZ 的系統性創新流程分為四個階段，依序藉由發散與收斂之分析過程，包括了定義問題、選擇創新工具、產生解題方案和評估方案，詳如圖 2 所示。

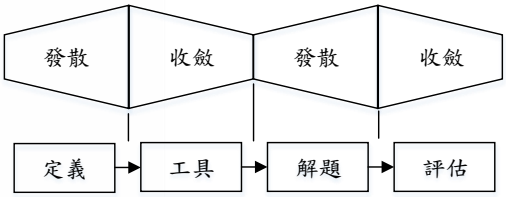

圖 2 TRIZ 之系統性創新解題流程圖
資料來源：Mann (2004)

矛盾矩陣與發明原則是 TRIZ 方法論裡最常使用的工具之一，因為在創新研發之中經常面臨的問題是欲改善一個產品或服務的屬性或特性時，卻導致另外一個屬性或特性惡化。傳統的方法是藉由妥協或取捨或是優化的方式來處理，而 TRIZ 則是利用消除矛盾的方法來發展創新方案。Altshuller 將技術矛盾的工程參數羅列 39 項。再藉由歸納分析超過 20 萬件的專利之後，將這 39 項工程參數間的矛盾建立一個 39x39 的矛盾矩陣，以供查表獲得相對應的發明原則，以幫助研發人員找到解決技術矛盾的創新想法。表 4 顯示，使用矛盾矩陣與發明原則時，先從矩陣之縱軸找出欲改善的參數，再由橫軸找出避免惡化的參數，對應矩陣表中的矛盾元素即為建議解決此矛盾的創新發明原則。

表 4 矛盾矩陣與發明原則

惡化參數 / 改善參數	1.移動物件重量	2.固定物件重量	…	39.生產力
1.移動物件重量				
2.固定物件重量				
:				
39.生產力	→	28 27 15 3		

Mann (2004)除了將原本的 39 工程參數擴充到 48 個，另外提出了商管領域之參數共 31 個。實際應用中，使用商管領域之矛盾矩陣與發明原則時，查表方法與典型的方法是一致的。在 31 個商管參數裡，參數 1 至 5 是攸關研發類(R&D)之商管參數，參數 6 至 10 是攸關生產或服務類(Production)之商管參數。參數 11 至 15 是攸關供應類(Supply)之商管參數，包括了生產原物料或服務資源的供給，同時也包括了生產或服務的行銷與物流配送作業。參數 17 至 20 是攸關支援類(Support)之商管參數，包括了生產或服務在送交給顧客之後的作業，例如維修、保養、退貨、回收或永續再利用。商管參數 16 是產品或服務的可靠性，參數 21 則為顧客營收或回饋。因此，為了問題之界定與參數之配送，本研究以環境教育認證場所界定為發展創新服務之系統，應用 Mann (2004)矛盾矩陣之商管參數，分析本研究之系統服務現況，詳如圖 3 所示。

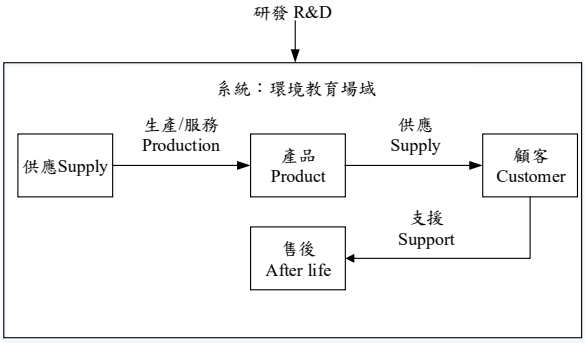

圖 3 環境教育認證場所之服務系統圖

4. 實證

依據本研究之架構圖，本文分成四個階段來發展環境教育認證場所之創新服務並實踐之。圖 4 顯示，階段一為建立訪談問卷。根據服務品質與生態旅

遊的理論，建立保證性、可靠性、社會面、環保面、經濟面、旅遊面、教育面和經營管理面等八個構面，以及表 3 之 10 題半結構式訪談問卷內容。

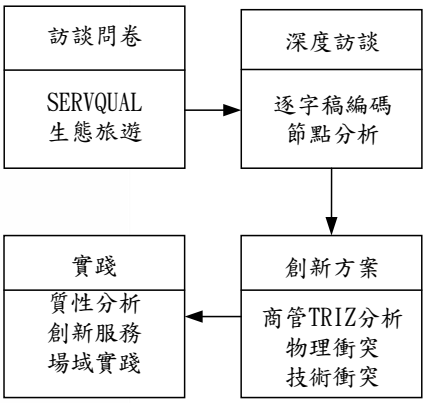

圖 4 實證流程

階段二:深度訪談

本研究進行二回合之深度訪談，第一回合之深度訪談目的在於逐字稿之編碼與節點分析。本階段訪談了產、官、學七位專家，分別包括了宜蘭縣二處通過環境教育認證認證場所之環教專案經理和課長，以及宜蘭縣環保局科長、基金會執行長、三位學者，詳如表 5 之受訪對象背景資料表所示。

每位受訪者均任職於環教之專業職務，且年資皆十年以上。每位的訪談時間約為 60 至 120 分鐘。為了完整記錄訪談內容，在受訪者同意下，訪談中全程除了以手稿記錄外並錄音留存，以便在訪談後轉成逐字稿。逐字稿完成後，經由第三人作檢核校正。後續則以 Nvivo 套裝軟體作逐字稿編碼與節點分析。逐字稿之編碼代號共分成四碼，第一碼表示所屬構面:Q 表示屬於服務品質構面,S 表示屬於社會構面,P 表示環保構面,N 表示經濟構面,T 表示旅遊構面,U 表示教育構面，M 表示經營管理構面。編碼代號第二碼代表受訪者，本研究以英文字母 A~G 隨機編碼代表受訪者。第三、四碼代表該受訪者的編碼流水號。

階段三:創新方案分析

本階段首先應用 Nvivo 軟體，針對每一份受訪者之逐字稿，逐句找出規律性和組織性的字詞或短語，以及文句所能涵蓋的主題。進而，將其選定的內容編碼到新建節點或現有節點，以建立節點與各個構面之次數分析。再應用 Mann (2004)之 TRIZ 理論，作商管屬性的配適分析。其中，表 6 為針對社會面、經濟面、旅遊面，和教育面之節點次數與商管參數配適表。其次，針對節點次數較多者，應用物理衝突與技術衝突之原則，逐一分析各構面之衝突辨識，詳如表 7 所示。最後，藉由矛盾矩陣、分離原則與系統轉移，應用發明原則以解決各構面的商管屬性之矛盾，來發展創新方案。

表 5 受訪對象之背景資料表

	受訪人職稱	年資	經歷	訪談日期	受訪時間
1	A 環教場所林經理	11	休閒農場專案經理	2016/10/24	2 小時
2	B 環教場所王課長	14	環保公司職安衛暨管理專員	2016/10/26	1.5 小時
3	某環保局-郭科長	24	環保署經濟部	2016/10/26	1.5 小時
4	大學環工系李主任	21	環保署環教認證審查委員 國家環教獎審查委員	2016/10/31	1.5 小時
5	財團法人基金會林執行長	11	社區發展協會理事長	2016/10/31	2 小時
6	大學環教中心黃主任	26	大學環境保護暨職安衛中心主任	2016/11/02	1 小時
7	環教輔導員兼環教中心汪主任	21	國小教師 宜蘭縣環教輔導團團員	2016/11/17	1.5 小時

表 6 構面之節點次數與商管參數配適表

構面	項次	節點	節點次數	商管參數	編碼(Code in vivo)
社會	1	商業模式	8	21	SA04-環境產業化 SE01-永續發展產業化
	2	環教宣導暨參訪	8	16	SB04-落實教育宣導與參訪
	3	環境承載	6	11	SC01-公開監測數據 SC02-生態的監測 SE02-旅遊的負荷量
	4	有機耕作	5	6	SF03-有機農業與農藥
	5	環境朔源	2	11	SD03-宜蘭早期少垃圾
	6	破窗效應	2	24	SD04-破窗效應 SD05-環境素養
	7	法規與公益	2	27	SA01-法規限制土地生態比例
	8	環教活動的效益	1	21	SD02-休閒遊憩活動的效益
旅遊	1	體驗與旅遊	64	6	TC01-環境中學習環教 TB01-推廣旅遊
	2	生態平衡	11	24	TC05-生態池生態平衡
	3	生態影響	5	24	TB04-影響整個生態環境
	4	自然資源	5	11	TD01-了解人與環境的關係
	5	休閒娛樂化	5	16	TB05-休閒娛樂呈現環教 TF01-生態旅遊
	6	體驗課程	4	6	TB07-五感體驗
	7	中小學參訪	2	6	TC02-國小的體驗參訪 TC03-國中的體驗參訪
	8	保育與保護	1	24	TG01-關渡自然公園
經濟	1	環教經濟效益	43	21	NF02-環教人員的培訓 NE04-環教經濟的收入 NA06-環教旅遊之經濟影響
	2	環教產業	10	21	ND01-政府讓環教成產業 NE01-環境教育商業模式
	3	創新服務	7	1	NE02-創新服務的環境教育
	4	收益	6	21	NG03-周邊收益支付環教
	5	收支平衡	6	7	NG02-環教資助收支平衡 NB02-環教財務規劃
	6	社會成本	6	17	NB01-環教基金補助 NF01-社會成本
	7	公益環教	2	7	NG03-周邊收益支付環教 NC01-公益的環境教育
	8	增能與外訓費用	2	2	NA01-環保署對環教的補助 NA02-增能計畫經費
教育	1	環境教育	289	6	UD09-環境教育的因子 UD10-環境覺知環境倫理觀
	2	教案	22	11	UA01-分齡教案 UD6 UA02-親子教案 UA08-教案翻譯
	3	增長知識與智慧	42	16	UD06-教案品質 UD10-增長知識 UD07-轉換成智慧
	4	參與	14	6	UG13-實際參與
	5	遊憩娛樂	12	16	UD05-休閒遊憩類的環教

					UB05-環境教育認證取得 UF03-環境教育不要變成遊戲 UG12-教育跟遊憩的結合
	6	導覽	12	6	UA06-多語言導覽
	7	行動力	9	6	UD03-環境行動力
	8	教育訓練	8	11	UE01-環教人員的培訓

表 6 顯示本研究藉由 Nvivo 進行逐字稿編碼後，依節點次數依序排列；並且歸納社會面、旅遊面、經濟面，和教育面等四個構面，進行節點內容與 31 個商管參數之配適。在社會面方面，節點次數最多的商管參數為參數 21(Customer Revenue / Demand / Feed-back)的 9 次，其次為參數 11(Supply Spec / Capability / Means)的 8 次，和參數 16(Product Reliability)的 8 次。藉由逐字稿之分析可得欲改善參數 21 將惡化參數 11 之矛盾現象，該矛盾即為技術衝突或稱工程衝突，如表 6 之項目 1 所示。再藉由 Mann (2004)之商管矛盾矩陣即可查表獲得對應的發明原則為 10, 03, 25, 05。

在旅遊面方面，節點次數最多的商管參數為參數 6(Production Spec / Capability / Means)的 72 次，其次為參數 24(System affected harmful effects)的 17 次。參數 6(建立人與環境之體驗學習)與參數 24(降低生態環境之干擾)互為衝突，但二者之間存在「生態場域之停留時間」為共同屬性；故該矛盾即為物理衝突，如表 7 之項目 2 所示。再藉由 Altshuller 與 Mann (2004)之五項分離原則和四項系統轉移之分析，可獲得對應的發明原則為 15,,34, 10, 9, 11, 01。另外，經濟面同樣依表 6 之參數 1 與財務支出參數(2, 7, 17)互為技術衝突，查表可得表 7 項目 3 之對應的發明原則為 15, 6, 1, 5。而教育面也同樣的依照表 6 之參數 16 之增長知識與智慧與遊憩娛樂互為衝突，但二者之間存在「教案與環教人員教育訓練」為共同屬性；故該矛盾即為物理衝突，可得表 7 項目 4 之對應的發明原則為 1, 2,3, 4, 7, 17, 35。

表 7 衝突辨識表

項目	衝突辨識	衝突類型	發明原則	創新方案
1	改善(環教產業效益)21 惡化(環境承載量)11	技術衝突	**10,** 03, **25, 05**	1-3
2	為了(建立人與環境之體驗學習)，(生態場域停留時間)要長 為了(降低生態環境之干擾)，(生態場域停留時間)要短	物理衝突	**15,,**34, 10, **9**, 11**(**分離原則之時間分離)；1(系統轉移之轉移到子系統)	4-6
3	改善(環境教育創新服務增能計畫)1 惡化(財務支出)12	技術衝突	**15, 6**, 1, **5**	7-9
4	為了(環境的關懷與實踐的具體行動力)，(生態知識解說)要多 為了(遊客的休閒娛樂效益)，(生態知識解說)要少	物理衝突	1, 2, **3**, 4, 7, 17(分離原則之空間分離) ；**35**(分離原則之狀況分離)	10-11

階段四:實踐

藉由 Altshuller 與 Mann (2004)之商管矛盾矩陣、物理衝突、分離原則、系統轉移分析，獲得表 7 衝突辨識表相對應之發明原則。之後，應用發明原則以對應各構面的商管屬性之矛盾，來逐一發展創新方案，共計 11 個方案。另外，本研究為了實踐這些服務創新方案，針對第一回合受訪之二處環境教育認證場所再度進行第二回合之深度訪談，訪談之對象與時間如表 8 所示。二位第二回合受訪者皆仍在原環教職場，且負責同樣的環教業務。因此，本研究針對表

7 之 11 個環境教育認證場所之服務創新方案，逐項進行深度訪談，實踐結果詳如表 9 所示。

其中，為解決表 7 項目 1：欲改善環教產業效益但惡化環境承載量之技術矛盾，應用發明原則 10(預先作用)，獲得服務創新方案 1 為：提供數位設施(VR/AR、Web camera)，使遊客在入園前體驗部份之遊憩效益，以降低環境負荷量。該方案在 B 場域得到實踐結果：已於 2021 年完成數位影片之重製。該數位影片長度為 15 分鐘，新增內容主題為環境之循環經濟，包括了焚化場發電功能之解說、廚餘再利用為培養土和土壤改良劑，以及熔爐底渣提供水泥廠再利用以大幅降低處理費用。

另外，為克服表 7 項目 2 之物理衝突：為了建立人與環境之體驗學習，生態場域停留時間要長，

但為了降底生態環境之干擾，生態場域停留時間要短。本研究應用了發明原則 15(動態化)，獲得服務創新方案 4 為：不定期之環境生態體驗產品。該方案在 A 場域得到實踐結果：生態觀察賞鳥方案。A 場域於 2021 年 5 月和 2022 年 5 月，新增規畫賞鳥空間，並用木製看板隔開鳥巢與賞鳥的客人。不僅客人可以安全地架設巨砲相機來記錄、欣賞藍鵲，而藍鵲也不會被打擾；除此之外，A 場域亦增加該賞鳥之入園經濟方案，以遠低於一般票價提供給賞鳥人士之門票和園區之午餐一份。而場域 A, B 在方案 6 皆無新增教案，主要原因為欲新增之環教教案需要通過環保署審查；故環教場域雖有依年齡、團體設計不同的體驗遊程內容，但因恐送審程序耗時而延用既有教案。

在表 7 項目 3：欲改善環境教育創新服務增能計畫，但惡化財務支出之技術矛盾，應用發明原則 6(多功能)，獲得服務創新方案 8 為：結合多種功能設施與同一環境中。該方案在 B 場域得到實踐結果：已於 2019 年新增 2-6 樓之走廊多功能動線廊道。內容整合了該環境教育之五大主題，分別為台灣垃圾發展史、資源回收、節能減碳、生生不息，以及氣候變遷。

最後，在克服表 7 項目 4 之物理衝突：為了環境的關懷與實踐的具體行動力，生態知識解說要多，但為了遊客的休閒娛樂效益，生態知識解說要少。本研究應用了發明原則 35(參數改變/特性的轉換)，獲得服務創新方案 11 為：提供產地到餐桌之一日農民體驗。該方案在 A 場域得到實踐結果：提供產地到餐桌之一日農民體驗。A 場域近年來致力於森川里海土地的守護，2022 年 4 月結合實作體驗及供應三餐，以轉化餐桌上的美食饗宴；並於 2022 年 7 月深化森川里海，帶遊客舉辦上山下海系列活動，活動名稱為：頭農川流溪 野餐惜食趣。該活動將生態知識解說融入於餐桌上的美食饗宴，具備了環境關懷與實踐的知識與智慧，也兼具了遊客的休閒娛樂效益。

表 8 第二回合受訪對象

	受訪人職稱	是否仍在原職	訪談日期	訪談時間
1	原 A 環教場所林經理	是	2022/7/18	1 小時
2	原 B 環教場所王課長	是	2022/7/19	1 小時

表 9 環境教育認證場所之服務創新方案與實踐

編號	發明原則	創新方案	場域實踐
1	10.預先作用	提供數位設施(VR/AR、Web camera)，使遊客在入園前體驗部份之遊憩效益，以降低環境負荷量。	B 場域已於 2021 年完成數位影片之重製。
2	05.合併，10 預先作用	提供大型遊覽車入園折扣以減少排廢量，並安排人員提早隨車服務解說。	A 場域目前規劃一天三輛大型遊覽車入園為環境承載量。 B 場域補助中小學生集體搭乘大型遊覽車來訪的車資，以減少排廢量。
3	25.自助	提供多元的環境生態體驗服務(如：種花、香草、種樹、插秧...)。	A 場域新增園藝、菜園、綠化旅行之「深呼吸專案」(2022/7)。料理名稱：富饒森林:餐盤周遭是因為保護森林，可以永續生產的富饒物產，為饕客們帶來充滿畫面的美食之旅。
4	15.動態化	不定期之環境生態體驗產品(花/鳥生態觀察)。	A 場域之賞鳥趣方案(2021/2022)。

5	09.預先反作用	愛它(生態)不要害它(生態)。	A 場域通過 GSTC 之國際永續旅遊認證(2019/7)。強調解說生態保持距離、剎那即為永恒，否則環境生態之反撲力量強大。
6	1 分割	環教體驗依需求、年齡、團體設計不同教案。	A, B 場域無新增教案。
7	15.動態化	提供數位化暨網路交易服務。	A 場域自建網路商城，以陳列場域之周邊商品並方便操作有彈性的價格政策。
8	6.多功能	結合多種功能設施與同一環境中。	B 場域於 2-6 樓走廊新增多功能動線廊道(2019)。
9	05.合併	結合外部夥伴建立創新之環境教育關係。	A 場域善用場所內、外部的夥伴來推動環境教育;與外部單位建立結盟關係，強化環境教育的推動與品質。包括鄰近之國小、港口社區和新港澳休閒農業區。 B 場域因屬危險場所，故對外部單位具有限制性之管制措施。
10	3.局部品質	提供局部區域強化知識性與娛樂性	A 場域將增設樹屋以融入環教的教案與生態的親和性。
11	35.參數改變	提供產地到餐桌之一日農民體驗。	A 場域致力於森川里海土地的守護，轉化餐桌上的美食饗宴(2022)。

5. 結論

依據國家教育研究院對環境教育之闡述，環境教育為保護環境資源和愛護自然環境的教育活動。其不僅在教導民眾了解並體認人與環境間交互作用時所必需的知能與態度，亦教育民眾在實際面對環境品質的課題時能作合理的決定，進而改善環境。另外，在貝爾格勒憲章(Belgrade Chart)裡更明確指出環境教育的目標有三，分別為培養對於都市及鄉間的經濟、社會、政治與生態之相互關係的意識與關切；提供每個人機會以獲得保護環境及改善環境所需要的知識、價值觀、態度、承諾和技能；為個人、群體和整體社會創造適應環境的新行為型態(黃富順，2000)。

國內在環境教育之發展亦不餘遺力，環保署於 2011 年頒發了第一處的環境教育場所認證標章予臺北市的關渡自然公園，開啟了環境教育之專業化並結合了國人的休閒旅遊。早期，宜蘭由於交通的阻隔，擁有好山好水的自然環境，使得通過環保署之環境教育場所認證之場域，密度居冠。近年來，交通的便利之後，宜蘭縣通過環境教育場所認證之數量成長似已停頓。因此，本文即以位居鄰近台北都會區，且擁有好山好水的宜蘭縣為研究對象，探討其環境教育場所之創新服務，以協助克服宜蘭近年來在環境教育認證場所遭遇的發展困境。

透過對環境教育相關之文獻回顧，本研究建立了環境教育認證場所之服務創新架構圖，以兼具環教之服務品質與生態旅遊特性。在創新的實證方面，本文分成四個階段、二回合的深入訪談，並應用質性分析與 TRIZ 方法論來發展服務創新方案。在藉由逐字稿之編碼、節點次數分析與 TRIZ 之商管參數衝突分析，辨識出四組之衝突，分別為二組的技術衝突與二組的物理衝突。接續應用商管矛盾矩陣、物理衝突、分離原則、系統轉移分析，以及相對應之發明原則，逐一發展出 11 個創新方案。

其中，第一組之技術衝突內應用了三項發明原則 10, 5, 25，發展出三個創新方案。第二組之物理衝突則應用了三項發明原則 15, 9, 1，同樣發展出三個創新方案。第三組之技術衝突也應用了三項發明原則 15, 6, 5，也發展出三個創新方案。第四組之物理衝突則應用了二項發明原則 3, 35，展出二個創新方案。在二處宜蘭縣環境教育認證場所之場域實踐結果，發現 A 場域在八個創新方案獲得實踐，而 B 場域在四個創新方案獲得實踐。唯一沒獲得實現的是第 6 個創新方案，可能原因是受限於場域裡的新增或修改教案，皆需送環保署審查核可；所以，在認證場所的環教人力和業務量的負荷之下，並不積極送審不同體驗需求者的更新教案。

最後，本研究之服務創新方案，除了可以作為其它環教認證場域之未來發展，以及提供給將要申請認證的環教場所之指引方向之外，也可以作為政府單位輔導環教場域發展之參考。然而，未來研究者仍可增加更多的場域實踐，以及結合環教人員實施量化調查之質性與量化之整合研究。並且，深入探討環境教育與循環經濟皆為未來之研究參考方向。

參考文獻

王照明、郭書伶(2017)。運用互動科技於博物館展示之環境教育體驗研究。臺中教育大學學報：人文藝術類，31(2)，1-21。

王順美、張子超、柯淑婉、陳素晴、陳富雄(2000)。大專環境教育通識 課程內涵架構之規劃。八十九年度環境教育研討會論文集，22-29。

王順美(2004)。台灣地區國高中全校式經營環境教育現況之探討。師大學報，49(2)，87-106。

王鑫(2002)，發展永續旅遊的途徑之一：生態旅遊。應用倫理研究通訊，24，28-44。

朱珊玟、吳連賞(2022)。鳖鼓濕地環境教育推動之永續機制初探。社區永續觀光研究，6(1)，33-49。DOI:10.6744/SCTS.202206_6(1).0003。

交通部觀光局(2002/2) 。歷年發展策略-台灣生態旅遊年，http://211.79.207.162/upload/content-File/auser/d/2002eco/news/Cnews.htm。

交通部觀光局(2017) 。交通部觀光局舉行「2017生態旅遊年」啟動記者會。https://admin.taiwan.net.tw/BigEvent-ListC002320.aspx?Pindex=40。

交通部觀光局(2022/7) 。108 條生態之旅推薦行程。https://www.tai-wan.net.tw/m1.aspx?sNo=0001038。

江昱仁、黃宗成、郭孟妮、張文娟（2008）。利用生態旅遊進行環境教育對學生環境認知、環境態度和環境行為的影響。運動休閒餐旅研究，3（4），69-99。DOI： 10.29429/JSLHR。

李晶、吳庭瑜、翁儷芯、歐懿慧(2013)，國家森林遊樂區生態旅遊地服務品質要素屬性之研究-以遊客的角度。休閒觀光與運動健康學報，20-39。

李佩真、施宜煌、葉彥宏(2020)。基隆市國小教師利用自然步道進行戶外環境教育之個案研究：以獅球嶺步道為例。臺中教育大學學報：教育類，34(1)，1-28。

吳忠宏、黃文雄、李介祿、李雅鳳(2007)。旅遊動機、滿意度與忠誠度之模式建構與驗證：以宜蘭賞鯨活動為例。觀光研究學報，13(4)，347-367。

吳鈴筑、王鴻濬(2012)。環境教育設施場所認證之實務分析。鄉村旅遊研究，6(1)，1-13。DOI:10.30169/JRTR.201206.0001。

林永禎、鄧志堅、白東岳(2018)。應用商業管理TRIZ 方法進行便利商店創新改良之案例分析-以新竹縣統一超商為例。International Journal of Systematic Innovation，5(1)，28-38。DOI：10.6977/IJoSI.201803_5(1).0004。

林明瑞、李春蓮(2020)。成為環境教育場域優秀解說志工之影響因素研究。觀光旅遊研究學刊，15(2)，61-83。

林明瑞、張廷鋐(2021)。學校選擇環境教育場域進行戶外教學之影響因素探討。臺中教育大學學報，35(2)，1-33。DOI： 10.7037/JNTUMST。

林明瑞、曾英雄、洪辰霖(2019)。環境教育場域解說志工之氣候變遷因應素養研究。觀光旅遊研究學刊，14(2)，59-81。

周儒(2000)。行動研究與教師環境教育能力之發展。台灣教育，589，22-28。

胡幼慧(1996)，質性研究—理論、方法及本土女性研究實例。台北：巨流。

徐筱琦(2015)。儒學思維與永續發展理念：國內環境教育政策內涵之審視。哲學與文化，42(9)，107-127。

晏涵文、馮嘉玉、劉潔心(2006)。我國學校環境教育指標之研究。師大學報：教育類，51(1)，85-102。DOI:10.29882/JTNUE.200604.0005。

姚映阡、湯幸芬(2016) 。生態旅遊地服務品質構面對體驗滿意影響效果—以烏來雲仙樂園銀髮族遊客為例。島嶼觀光研究，9(1)，40-72。

高翠霞、張子超(2016)。環境教育的發展脈絡與融入十二年國教的方法。課程與教學，19(2)，27-51。DOI:10.6384/CIQ.201604_19(2).0002。

許世璋、任孟淵. (2014)。培養環境公民行動的大學環境教育課程—整合理性,情感，與終極關懷的學習模式。Chinese Journal of Science Education，22(2)，211-236.

許芳瑜(2006)。環境教育在台灣－綠色學校伙伴網路計劃。休閒運動期刊，(5)，119-127。DOI:10.29909/IWCMAT.200605.0013。

許棟樑(2015)。萃智創新工具精通:上冊(四版)。亞卓國際顧問股份有限公司。

教育部社會責任推動中心(2022/6/24) 。第三期大學社會責任實踐計畫徵件說明。https://usr.moe.gov.tw/announce。

莊潔、高翠霞(2021)。2011－2020 年環境教育人員認證展延分析。環境教育研究，17(1)，1-48。DOI:10.6555/JEER.17.1.001。

張子超(2019)。十二年國教環境教育議題融入的課程發展－以永續發展主題為例。學校行政，(123)，54-67。DOI:10.6423/HHHC.201909_(123).0004。

陳偉星(2015)。TRIZ 原理在人力資源管理的應用。International Journal of Systematic Innovation，3(3)，14-27。DOI：10.6977/IJoSI.201503_3(3).0002。

陳敬能、洪甄憶(2011)。學校推動環境教育之可行性分析。亞洲高齡全人健康及產業發展期刊，(1)，150-161。DOI:10.6263/ASHLE.201112_(1).0014。

郭晴之、荊溪昱(2016)。行動學習應用在校本環境教育課程之研究。工業科技教育學刊，(8)，12-20。DOI:10.6306/JITE.201610_(8).0002。
黃志成、謝孟君、江依芳 (2004)。以生態旅遊觀點探討承載量影響因素-以日月潭國 家風景區為例。生物與休閒事業研究，1(1)，125-140。
黃富順(2000)，教育大辭書。國家教育研究院。https://terms.naer.edu.tw/detail/1314915/。
黃聖茹、蘇宥儒、雷立芬(2018)。從遊客觀點探討環境教育、滿意度與重遊意願之關係－以台北植物園為例。農業經濟叢刊，24(1)，57-82。DOI:10.6196/TAER.201806_24(1).0003。
楊冠政(1993)。環境素養。環境教育季刊，19，2-14。
楊冠政(1997)。邁向永續發展的環境教育。環境科學技術教育專刊，高雄師大環境教育中心。
歐陽宇、劉亭妤、楊朝行(2017)。溫泉生態旅遊融入環境教育之行動研究。中華創新發展期刊，4(2)，107-121。DOI:10.30141/JID.201705_4(2).0009。
劉宗聖等人(2019) 。ESG 12 堂趨勢課：用最簡單的方式，找到永續的投資價值。經濟日報出版社。
劉惠珍、莫皓帆、林宏盛(2013)。社區生態旅遊服務品質與遊客體驗滿意度的關連組集模式之探討-基於典則相關分析技術。觀光旅遊研究學刊，8(1)，39-60。
劉惠國、何月妃(2016)。遊客對環境教育場所服務品質之研究－以深溝水源生態園區為例。觀光與休閒管理期刊，4(1)，99-108。DOI:10.6510/JTLM.4(1).09。
劉惠國、江昱仁、張景棠(2016)。遊客對環境教育設施場所服務品質之研究－以台北市自來水園區為例。運動與遊憩研究，10(4)，19-38。DOI:10.29423/JSRR.201606_10(4).0002。
劉源隆、溫桓正、莊家春、黎瑞雍(2021)。能源暨環境教育研發桌遊創新應用。電工通訊季刊，86-94。DOI:10.6328/CIEE.202103_(1).0009。
環境保護署(2019/3)，107 年環境白皮書。
環境保護署(2022/7)，環境教育終身學習網，https://elearn.epa.gov.tw/faq-list.aspx?type=1。
鍾惠婷、陳志賢(2017/2)，以生態旅遊觀點探討環境教育場所之服務品質，觀光與休閒管理，5，53-60。
羅玉青(2015)。百年農業創新環教－本場榮獲第 4 屆苗栗縣環境教育獎特優。苗栗區農情月刊，19(3)，2-2。
羅雅怡(2017)。我國環境公益信託制度介紹與展望－以「自然谷環境教育基地」為例。土地問題研究季刊，16(4)，128-135。
薛博聞、方韻如(2015)。貢寮水梯田保育新嘗試－公眾教育與環境教育推動。臺灣博物季刊，34(2)，48-55。
蘇金柱、陳宜清、林德勳、楊玉蓉(2021)。休閒農場導入環境教育與食農教育之整合策略研究。全球管理與經濟，17(1)，69-76。

References

Bitner, M. J. (1990). Evaluating Service Encounters: The Effects of Physical Surroundings and Employee Responses. Journal of Marketing, 54(2), 69-82.
Chai, K. H. & Zhang, J., & Tan, K. (2005). A TRIZ-based method for new service design. Journal of Service Research, 8, 48-66. 10.1177/1094670505276683.
Chan, H. T. & Chen, J. L. (2003). Eco-Innovative Examples for 40 TRIZ Inventive Principles, The TRIZ Journal, August, https://the-trizjournal.com/eco-innovative-examples-40-triz-inventive-principles/.
Gadd, K. (2011). TRIZ for Engineers. John Wiley & Sons, West Sussex, UK.
Garvin, D. A. (1984). What Does Product Quality Really Mean? Sloan Management Review, 26(1), 25-43.
Garvin, D. A. (1987) Competing on the eight dimensions of quality, Harvard Business Review, 65, 6, 101-109.
Hetzer, N. D. (1965). Environment, tourism, culture, Links, 1, 1965.
Holden, A. & Fennell, D. (2012). The Rutledge Handbook of Tourism and the Environment, Rutledge Publisher. https://www.routledgehandbooks.com/doi/10.4324/9780203121108.
Karagiannis, S. & Polo, A. (2011). Tourist Ecology Politics: The Case of Crete Greece and Saranda Albania. Tourism and hospitality management, 17(2), 267-278. DOI:10.20867/thm.17.2.7.
Khursheed, W., Khah, S., & Rao. (2011). Ecotourism and the Impact of the Conventional Tourism on the Fragile Ecosystem, International Journal of Science and Nature, 2(3), 432-442.
Leon, N. (2010). Putting TRIZ into product design, Design Management Review, 14(2), 58-64.
Mann, D. (2004). Hands on Systematic Innovation: For Business and Management, IFR Press, Clevedon, BS21 7WD, UK.
Marsh, D. (2004). 40 Inventive Principles with Applications in Education, The Triz Journal, April, https://the-trizjournal.com/40-inventive-principles-applications-education.
Marsh, D., Waters, F ., & Mann, D., (2002), Using TRIZ to Resolve Educational Delivery Conflicts

Inherent to Expelled Students in Pennsylvania, European TRIZ Association Conference, Strasbourg France, November, 6-8.
Parasuraman, A., Zeithaml, V. A., & Berry, L. L. (1985). A Conceptual Model of Service Quality and its Implications for Future Research. Journal of Marketing, 49(4), 41-50.
Parasuraman, A., Zeithaml, V. A., & Berry, L. L. (1988). SERVQUAL: A Multiple Item Scale for Measuring Consumer Perceptions of Service Quality. Journal of Retailing, 64(Spring), 12-40.
Patton, M. Q. (1999). Enhancing the Quality and Credibility of Qualitative Analysis. Health Services Research, 34, 1189-1208.
Quinn, R. E. & Rohrbaugh, J. (1981). A Competing Values Approach to Organizational Effectiveness. Public Productivity Review, 5(2), 122-140.
Rahman, N., Halim, L., Ahmad, A., & Soh, T. (2018) Challenges of Environmental Education: Inculcating Behavioral Changes among Indigenous Students. Creative Education, 9, 43-55. DOI: 10.4236/ce.2018.91004.
Retseptor, G. (2003). 40 Inventive Principles in Quality Management, The TRIZ Journal, March, https://the-trizjournal.com/40-inventive-principles-quality-management/.
Palmer, J. A. (1998). Environmental Education in the 21st Century: Theory, practice, progress, and promise. New York: Rutledge.
Retseptor, G. (2005). 40 Inventive Principles in Marketing, Sales and Advertising. TRIZ Journal, April.
Ross, S. & Wall, G. (1999). Ecotourism: towards congruence between theory and practice, Tourism Management, 20, 123-132.
Savranksy, S. D. (2000). Engineering of creativity-Introduction to TRIZ methodology of inventive problem solving: CRC Press.
Sokovic, M., Pavletic, D., & Fakin, S. (2005). Application of Six Sigma Methodology for Process Design, Journal of Material Processing Technology, 777-783.
Souchkov, V. (1997). Accelerate innovation with TRIZ. Retrieved from http://www.xtriz.com/publications/AccelerateInnovationWithTRIZ.pdf.
Stone, L. S. & Stone, T. M. (2011). Community-based tourism enterprises: challenges and prospects for community participation; Khama Rhino Sanctuary Trust, Botswana. Journal of Sustainable Tourism, 19(1), 97-114.
Weaver, D. B. & Lawton, L. J. (2007). Twenty Years on: The State of Contemporary Ecotourism Research, Tourism Management, 28, 1168–1179.

作者簡介

陳志賢 2007 年以來在佛光大學管理學系擔任副教授。他曾在南亞科技公司和中衛發展中心擔任生產管理工程師和企業診斷顧問之產業經驗。該員從台灣科技大學獲得管理學博士學位和管理學碩士學位。他自 2012 年起擔任宜蘭學論文專書的主編。研究領域包括 TRIZ、服務品質、民宿管理和企業診。

鍾惠婷畢業於佛光大學管理學碩士班，現職為專業之環境教育專員。她擔任過勞動部勞動力發展署手創 DIY 教學課程之外聘講師，並曾自行開業補教教育約 11 年。該員通過行政院環保署之環境教育人員認證，之後於環境教育認證場所工作達 11 年。

DOI: 10.6977/IJoSI.202212_7(4).0005
L. Wu, C. Tseng / Int. J. Systematic Innovation, 7(4), 67-83 (2022)

Exploring customer perceived value and impulsive buying behavior of LINE stickers: Moderated by interpersonal influence

Luo-Ling Wu, Ching-Chih Tseng*
Department of Business Administration, DaYeh University, Taiwan
*Corresponding author, Email: cctseng@mail.dyu.edu.tw
(Received 7 July 2022; Final version received 23 November 2022; Accepted 27 November 2022)

Abstract

The prevalence of mobile communication software has made the communication between each other more diversified and gradually integrated into each other's life. Among them, LINE's vivid and funny stickers are generally loved by the public, and the business opportunities it can bring are huge. Whether consumers may be affected by sticker advertisements or price promotions in the process of purchasing LINE stickers, which may lead to impulsive buying behavior, is a topic worthy of study. Therefore, the purpose of this study is to use the stimulus-organism-response (S-O-R) model as the framework to explore how the perceived value (utilitarian and hedonic value) of users of the LINE affects their impulse buying behavior in the context of LINE community interaction. In addition, this study also uses interpersonal influence as a moderator and examines its impact on the correlation between consumers' perceived value and their impulsive buying behavior. This study collected a total of 354 valid samples through various social media, such as FB and LINE. The analysis results show that the portability and visual appeal of LINE stickers will positively and significantly affect consumers' feelings of hedonic value and utilitarian value at the inner psychological level, and then significantly affect consumers' impulse buying behavior. Stickers have a personal preference problem and are less able to be controlled by others, so the interpersonal influence has no mediating effect between perceived value and impulsive buying behavior.

Keywords: LINE sticker, Stimulus-organism-response (S-O-R) model, Environmental stimuli, Perceived value, Impulsive buying behavior, Interpersonal influence.

DOI: 10.6977/IJoSI.202212_7(4).0005
L. Wu, C. Tseng / Int. J. Systematic Innovation, 7(4), 67-83 (2022)

探討 LINE 貼圖顧客知覺價值和衝動性購買行為—以人際影響力為調節

吳洛羚　曾清枝*
大葉大學企業管理學系
*通訊作者 E-mail：cctseng@mail.dyu.edu.tw
(Received 7 July 2022; Final version received 23 November 2022; Accepted 27 November 2022)

摘要

手機通訊軟體的盛行讓彼此之間的溝通更加多元化，同時也漸漸融入了彼此的生活中。其中，LINE生動風趣的貼圖普遍受到大眾所喜愛，且能帶來的商機非常龐大。消費者在購買LINE貼圖的過程中，是否可能會受到貼圖廣告或降價促銷等影響，而產生衝動性購買行為，是一個值得去研究的議題。因此，本研究目的以刺激—有機體—回應(S-O-R)模型為架構，探討手機通訊軟體LINE使用者的知覺價值（功利和享樂價值）如何影響他們在LINE社群互動背景下的衝動性購買行為。另外，本研究也將人際影響作為調節因素，並檢定其對消費者知覺價值與其衝動性購買行為之間相關性的影響。本研究透過各社群媒體，如FB和LINE等，共蒐集到354份有效樣本。分析結果顯示顯示LINE貼圖的可攜性、視覺吸引力會正向顯著影響消費者內在心理層面的享樂價值和功利價值的感受，進而正向顯著影響消費者的衝動性購買行為，另外，因LINE貼圖存在個人偏好問題較無法被他人左右，所以人際影響力在知覺價值與衝動性購買行為之間並無調解作用。

*關鍵詞：*LINE貼圖、刺激—有機體—回應模型、環境刺激、知覺價值、衝動性購買行為、人際影響力

1. 前言

隨著媒體技術的發展跟網路流通效率的大幅提升，致使社群 APPs 日漸盛行，在人人都擁有手機的情況之下，人們溝通方式與溝通媒介的選擇也日益多元，而社群 APPs 創造了各類的商機以及廣告的效益，其中 LINE 訊息交流的方便性以及多樣化的貼圖更是融入了大家的生活及工作，成為人與人聯繫情感中重要的工具之一。

過去關於LINE貼圖研究大都是偏向挖掘LINE貼圖的企業價值(高嘉懌，2020；賴秋妏，2017；張玉琳與李秋滿，2014)，且儘管衝動性購買行為在這幾年探討過許多不同面向的議題(Parboteeah et al., 2009; Chen et al., 2020; Sihombing et al., 2020; Yang et al., 2021; Zhang et al., 2020)，但在行動商務環境中探討衝動性購買行為的面向依舊有限(Anwar et al., 2021)。Zheng et al. (2019)表示擁有具體技術特徵的行動商務，可以增進消費者對產品的衝動性購買行為，但哪些技術特徵可能會激發消費者的感受，進而促使衝動性購買行為發生尚未得到充分研究。

電子商務的相關研究中已經認識到技術特徵對個人認知、情感和行為的影響(Cho et al., 2019; Kukar-Kinney et al, 2009; Parboteeah et al., 2009; Adelaar et al., 2003; Zheng et al., 2019)。其中，當談到行動商務時，可攜性及視覺吸引力更是吸引用戶使用行動商務的關鍵特徵(Mendez, 2013)。在可攜性方面，Junglas and Watson (2006); Gao et al., (2009)指出網路無處不在就意味著可攜性的特質，這使得我們能夠跨越空間和時間限制進行廣泛的覆蓋；在視覺吸引力方面，平台的美感，可以透過語言、色彩、佈局、動畫等元素來表達(Li and Yeh, 2010)，在過去有諸多研究針對圖片進行網站美感與吸引力的探討，證實圖片的呈現與視覺吸引力具有關聯性(Knutson, 1998)，而Parboteeah et al., (2009)研究指出：視覺吸引力與字體和其他視覺元素(例如圖形)的展示有關，可以增強網絡的整體表現力；行動商務的介面與傳統網站的介面存在著差異；行動商務的視覺吸引力就比傳統網站顯得更加重要。

然而知覺價值來自於消費者與環境之間的互動，消費者受到外在環境的刺激是其衝動性購買行為

的關鍵前因(Huang et al., 2019)。Ryu et al., (2010)認為知覺價值(包含功利價值及享樂價值)是消費者在消費經驗中評價的基礎，透過這兩個構面可以更完整的呈現了消費者的知覺價值，Carpenter(2008)認為消費者經過體驗後會產生購物價值(shopping value)，購物價值包含從產品本身獲得的功利購物價值及情感層面感受到享樂購物價值。

本研究採用S-O-R模型作為本研究之研究架構，S-O-R模型在行銷領域受到廣泛地應用於解釋行動消費者行為(Chopdar and Balakrishnan, 2020; Yang et al., 2021)，LINE貼圖購買行為亦屬行動商務之一環。為實現本研究的目的，本研究提出以下研究問題：(1)LINE貼圖中哪些環境因素會誘發消費者的知覺功利價值知覺享樂價值？ (2) 知覺功利價值知覺享樂價值是否都會影響消費者在LINE貼圖中的衝動性購買行為？(3)人際影響與消費者知覺價值的交互作用是否會導致LINE貼圖中的衝動性購買行為？

2. 文獻探討

2.1. S-O-R模型

S-O-R (Stimulus-Organism-Response) 模型由Mehrabian and Russell (1974)提出，該模型是假設環境因素刺激 (S) 可以促進有機體(O)個人的內部過程(認知和情感反應)，從而進一步誘導他們的行為反應 (R)。根據 S-O-R模型，LINE(動態)貼圖因素等刺激會影響個人內部認知和情感反應的狀態(Zhang et al., 2014)。 S-O-R 的第二部分是有機體，模擬個體處理刺激的內部過程，例如，使用者受到LINE(動態)貼圖的刺激而產生的認知和情感知覺的變化。反應一詞描述了刺激的結果和個人的內部過程(Jacoby，2002)。本研究將環境因素(可攜性和視覺吸引力)視為是影響消費者個體的知覺功利價值和知覺享樂價值並最終影響消費者衝動性購買行為。

本研究採用S-O-R 模型的理由有二：其一是廣泛用於研究環境、情緒和行為之間的關係，如：網站、電商平台、實體店面、直播平台、社交平台等，也為不同背景的衝動性購買行為奠定了基礎，S-O-R模型在過去十年仍然是線上衝動性購買行為最流行的理論方法(Yang et al., 2021; Zhang et al., 2020; Zheng et al., 2019 ; Parboteeah et al., 2009; Chen et al., 2020; Floh et al., 2013; Sheng et al., 2012)；其二是S-O-R模型提供了一種結構化的方法來探索LINE貼圖的不同環境刺激對消費者知覺(認知和情緒知覺)的影響，進而影響消費者的衝動性購買行為。

2.2. LINE 貼圖產品特徵作為刺激(S)

在使用LINE通訊軟體環境中，消費者使用LINE和貼圖大部分是透過筆電或如手機等行動裝置來進行的。這種情況下，我們假設LINE通訊軟體和其貼圖的產品特定特徵具有可攜性和視覺吸引力，此特徵作為環境刺激，誘導消費者的價值知覺，從而進一步影響他們的衝動性購買行為。行動裝置上LINE的可攜特性，使其與用戶每日生活密切結合，可攜性是行動裝置的物理特性，使它們能夠長時間攜帶。指出網路無所不在就意味著可攜性的特質(Junglas and Watson, 2006; Gao et al., 2009)。這使得我們能夠跨越空間和時間限制進行廣泛的覆蓋，在本研究中意旨行動裝置的隨處性或空間和時間的組合靈活性。

Van der Heijden (2003)提出視覺吸引力(Visual attractiveness)的概念，並定義為一個人認為網站在視覺上美觀的程度。Lindgaard et al., (2006) 認為視覺吸引力是對於網頁第一印象的視覺美觀程度，也是使用者對網站美感上的主觀感受。Adelaar and Chang (2003) 宣稱：生動、個性化和詳細的圖形展示將在視覺上吸引消費者，並進一步激發消費者對產品的興趣及內在的情感反應，且圖片越生動，能獲得的情感認可度就越高。LINE動畫貼圖就存在這樣的特徵。(Huang, 2016)認為視覺吸引力是行動商務行銷人員重視吸引消費者的另一個重要組成部分(Chopdar and Balakrishnan, 2020)，因為之前的研究證實視覺促銷(視覺吸引力)會刺激消費者購買行為(Law et al., 2012; Zheng et al., 2019)。

2.3. LINE貼圖消費者知覺價值作為有機體(O)

與環境刺激互動會導致消費者產生認知和情知覺。 認知(情感)知覺是指消費者在暴露於環境刺激時，其頭腦中發生的認知(情感)中介過程(Chang and Chen，2008)。本研究借鑒消費者知覺價值的視角，將知覺功利價值視為一種認知反應，並將知覺享樂價值視為一種情感反應。Ryu et al. (2010) 認為知覺價值(功利價值、享樂價值) 是消費者對於消費經驗評價的基礎，透過這兩個層面可以將消費者的價值更完整的呈現。Carpenter (2008) 所提到：消費者經過體驗會產生購物價值，包含從產品的功利價值及情感層面的知覺價值(功利、享樂)。因此，知覺價值

是透過一連串完整的體驗而產生的。Sheng and Teo(2012)指出行動商務同時擁有功利及享樂構面，，因此本研究將知覺價值分為知覺功利價值與知覺享樂價值兩個構面：。

(1) 知覺功利價值

Engel et al. (1993)認為功利價值是一種任務、理性、有效決策和目標導向的，Strahilevitz and Myers (1998)將功利價值定義為產品的功能及對消費者有幫助的價值，Overby and Lee (2006)進一步解釋並定義功利價值為顧客在考量了產品、服務、價格等特性後，對其付出與實質利益的評估，注重產品的功能性，在消費者滿足和任務相關需求時，強調了工具性和外在性。

根據上述對功利價值的定義帶入到LINE貼圖的購物環境中可知，功利價值視是一種理性價值，會有一項或多項的「任務目標」，注重產品「功能性」(效率、易用性、節省時間)以及對自身「有效的幫助」來衡量產品價值，和享樂價值相較起來也擁有更多的「認知度」，故本研究LINE貼圖的功利價值定義為：購買貼圖時會根據自身的追求的目標(即貼圖能幫我完成的任務)，及貼圖的功能性對消費者幫助的意義。

(2) 知覺享樂價值

Hoffman and Novak(1996)將享樂價值(Hedonic Value)定義為體驗性利益與犧牲的全面性評估，重視體驗的過程，享樂價值的特徵是自我為目的和自我為導向，只要在體驗的過程中感到愉快就能實現享樂價值(Adomaviciute, 2013)，比起功利價值更加來得主觀並且比起購物任務的完成而言，更多源自於購物過程中所獲得的享樂感(Holbrook and Hirschman, 1982)。

根據上述對享樂價值的定義帶入到LINE貼圖的購物環境中可知，享樂價值視為是一種重視「自我感受」的非理性價值，追求「愉悅感」及「體驗感」與「自我實現的欲望」相關，並伴隨與「幻想、感覺、樂趣及符號意義」有關的元素(Hirschman and Holbrook, 1982)，LINE貼圖讓用戶彼此之間聊天的過程能增加情緒、情感態度及情境上的表現，在接收非語文的訊息時更會增強用戶彼此間的心理知覺，讓雙方有感覺近似面對面互動的程度(Short et al., 1976)，而貼圖擁有不同的類型的情境式變化及特效，提升了使用貼圖的樂趣，故本研究LINE貼圖的享樂價值定義為：「購買貼圖時會根據當時自我的主觀感受和慾望(即想表達的情緒、情感態度及情境，偏好的貼圖類型…等)，及貼圖的功能性體驗對體驗者帶來的感覺」。

2.4. 衝動性購買行為作為反應(R)

消費者的認知和情感反應將決定他們對環境刺激的反應(Parboteeah et al., 2009)。在本研究中，衝動性購買行為被視為回應。在行銷研究領域中，衝動性購買行為被描述為無計劃的購買行為(Cobb and Hoyer, 1986)。在網路發達之現今，線上購物也越發的貼近生活日常，幾乎有90%的消費者都曾在購物時，發生過衝動性購買的經驗(Welles, 1986)，與實體商店相較之下，線上環境中的消費者被認為更具有衝動性購買之傾向，主因在於現代人消費型態由線下變成線上，網際網路更容易激發出衝動性購買的情境(Rook and Fisher, 1995)。衝動性購買行為意旨「非計畫」、「非理性」，沒有經過思考了解而立即決定的購買決策。在購物的過程中因受到了外在誘因的刺激，導致當時內心不受自我理智所控制，而不由自主衝動消費的購買行為，通常都是「突然的」的情況下產生購買行為，時常伴隨著情感及情緒狀態及當時強烈的慾望，使消費者產生衝動性購買行為。

在早期的研究中，Stern(1962)以非計畫性來定義衝動性購買的行為，將衝動性購買行為劃分為四種概念組合：(1)純粹衝動性購買(pure impulse buying)、(2)回憶性衝動性購買(reminder impulse buying)、(3)建議性衝動性購買(suggestion impulse buying)、(4)計畫性衝動性購買(planned impulse buying)，然而消費者會因為貼圖本身的吸引力、以及自身的心情、貼圖所帶來等情境等等，導致發生衝動性購買行為，屬於內心層面的影響，而純粹衝動性購買行為是由情緒等內在因素所導致的購買行為。由此可推論，本研究中LINE貼圖是屬於純粹衝動性購買行為，再根據Rook and Fisher(1995);Lin and Chen (2012);Verhagen et al.(2011)的研究，本研究將衝動性購買行為定義為「消費者不經由考慮而購買貼圖產品」。

2.5. 人際影響力

人際影響力主要包括為達到特定效果而採取行動說服、說服或影響他人的影響。個人行為的一個重要決定因素是他人的影響(Bearden et.al., 1989)。根據社會認知理論，人際影響的過程提倡一種雙向的相互作用，這種相互作用也發生在環境和個人特徵之間(Bandura, 1977;1986;1989)。作為這一過程的一部分，環境中的社會影響和物理結構會發展和改變人類的期望、信念和認知能力。此外，由於年齡、

體型、種族、性別和身體吸引力等身體特徵，人類會從社會環境中引起不同的反應。

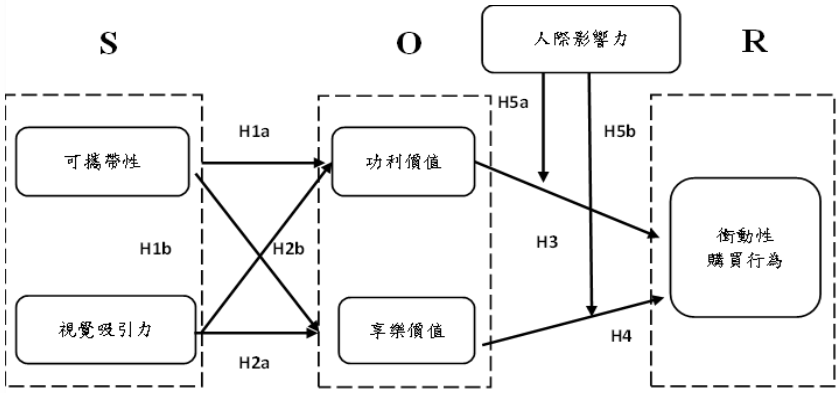

圖 1　本研究模型

3. 研究模型和假設發展

3.1. 研究模型

本研究採用 S-O-R 模型作為研究架構，並採用可攜性和視覺吸引力作為LINE社群軟體中的環境刺激，並研究LINE貼圖的知覺功利價值和知覺享樂價值如何受這兩種刺激的影響。知覺功利價值和知覺享樂價值直接促進了消費者的衝動購買行為，而這些關係會受到人際影響的干擾。圖 1 表示本研究的研究模型。

3.2. 假設發展

3.2.1. 環境刺激和消費者知覺價值

本研究採用可攜性和視覺吸引力作為LINE貼圖消費的環境刺激，引發消費者知覺價值(即知覺功利價值和知覺享樂價值)。可攜性說明了行動裝置的物理特性，它足夠輕，可以攜帶 (Kim et al., 2010)。過去的研究將可攜性視為行動商務的最大優勢，因為它允許消費者隨時隨地接觸到產品資訊(Hsieh et al., 2021; Ashraf et al., 2017; Hubert et al., 2017; Anwar et al., 2020)。因此，使用可攜式的移動設備，消費者可以隨時隨地瀏覽他們想要的LINE貼圖商品。另Kim et al., (2013)對品牌Apps的研究顯示，Apps的交互功設置因人而異變得”風格化”。

綜合上述文獻，透過智慧型手機，消費者可不受費者的娛樂感。因此，本研究提出下列假說：

H1b.LINE貼圖的可攜性對消費者的享樂價值產生正向顯著影響

能可以增加參與度，假設移動設備的“隨時隨地”交互性和易於控制使它們比計算機網站更容易使用，從而提高知覺的有效性，也能夠為客戶提供各種優勢，增強功利價值。

綜合上述文獻，透過行動裝置，消費者可以隨時隨地打開LINE貼圖小舖，讓消費者能更快的搜尋他們想要的LINE貼圖訊息，節省了購物時間，也提高了他們的購物任務的性能，也能立即滿足消費者的購物需求，而智慧型手機的可攜性讓使用者能隨時的點開聊天室回復訊息，而使用LINE貼圖能使消息的回覆更有效率。因此，本研究提出下列假說：

H1a.LINE貼圖的可攜性對消費者的功利價值產生正向顯著影響。

在行動商務環境中，消費者與產品的互動是通過行動商務的介面進行的，消費者借助不同的多媒體技術、準確的偏好預測和易於使用的行動設備，讓虛擬行動購物環境能夠有效地刺激消費者，激發他們的享受和興奮情緒(Rook, and Gardner, 1993)，而行動商務不受常規商務的地域和時間限制，消費者可以隨時隨地與行動電子商務賣家進行交流和賣家之間增加的互動，進而誘發消費者的享樂感(Zheng et al., 2019)，由此可知這種可攜性對於智慧型手機來說是必不可少的，並且由於尺寸更小，介面的

常規商務的地域和時間限制，隨時隨地使用LINE貼圖所帶來的體驗感，而與人互動也能從中滿足消

Van der Heijden and Verhagen (2004)提出了“知覺吸引力”的概念，它描述了一個網站在美學上令人愉悅的程度，並觀察到網站的視覺吸引力可以讓

消費者積極地增強自身的知覺享受，另外，一項關於行動商務環境的研究表明，知覺視覺吸引力對促進享受和愉悅有顯著影響(Cyr et al., 2006)。在移動環境中，品牌應用程序的美學設計很可能可以提供氛圍線索，幫助個人感受到享受和愉悅。

消費者在瀏覽產品時可能會根據平台的視覺外觀來決定是否繼續購物(Wang et al., 2011)，而有吸引力的界面會吸引到消費者目光的停留，從而使他們進一步探索移動電子商務(Merhi, 2016)。之前的研究還驗證了網站視覺吸引力對個人享樂價值的影響(Parboteeah et al., 2009; Xiang et al., 2016; Hsieh et al., 2021)。因此，本研究提出下列假說：

H2a.LINE貼圖的視覺吸引力對消費者的享樂價值產生正向顯著影響

有研究表明寬頻的增加有助於在電子商店設計中使用高清照片和視頻(Floh and Madlberger, 2013)。這些高質量的照片和高品質的影音資訊，可以幫助網站能使消費者的停留時間變長，也讓消費者在瀏覽的過程中更加流暢，而功能性設計可以增加客戶的知覺價值。與網站相關的視覺美學可以增加消費者的線上購物價值(Cai and Xu, 2011)。

有文獻表明視覺吸引力可以引起消費者的積極態度，增加他們對功利價值的看法(Cyr et.al., 2006; Chopdar and Balakrishnan, 2020)。綜合上述文獻，行動商務的視覺吸引力幫助消費者有效地搜索、瀏覽和評估他們想要和需要的產品，從而提高他們的購物任務績效。因此，本研究提出下列假說：

H2b.LINE貼圖的視覺吸引力對消費者的功利價值產生正向顯著影響

3.2.2. 消費者知覺價值和衝動性購買行為

衝動性購買行為是一種享樂的和突然的複雜行為，排除了對替代品的深思熟慮的考慮(Beatty and Ferrell,1998)。Sharma et al. (2010) 指出低認知會導致衝動性購買，常會在不考慮後續的狀況下產生。但功利價值被定義為關鍵任務、理性、有效決策和目標導向及利益的總體評估(即判斷)，換句話說，當消費者在購買商品之前會考慮產品、服務及價格等特徵(Lee and Wu, 2017; Overby and Lee, 2006)。根據上述文獻評估出功利主義消費者通過瀏覽來獲取符合他們期望的資訊或產品，進而引發衝動性購買行為。因此，本研究提出下列假說：

H3. LINE貼圖的功利價值正向顯著影響消費者的衝動性購買行為

日常生活中消費者往往在自己不自覺情況下發生衝動性購買。也有研究表明這過程中消費者經常會經歷情感上的反應提升衝動性購買行為發生(Y. Chen et al., 2019; Beatty and Ferrell,1998; Xiang et al., 2016)。因此，本研究提出下列假說：

H4. LINE貼圖的享樂價值正向顯著影響消費者的衝動性購買行為。

3.2.3. 人際影響力扮演調節角色

消費者往往會受到周圍人的看法的影響而去衡量自己是否需要(Yoon et al, 2011)，消費者在購物之前會傾向於與朋友交流他們最喜歡的產品服務及其折扣，在這雙方的互動之中從而產生享樂價值。例如，Arnold and Reynolds (2003)提出追求享樂購物價值觀的購物者在購物時可能會尋求他人的建議和指導；Olsen and Skallerud (2011)表明，個人互動可能有助於提供享樂購物價值。

而為了實現他們的購買目標及任務，他們需要從各類管道得知目標任務更多的資訊和高質量的訊息，再根據訊息的統整分析，進而做出購買決策(To, Liao and Lin, 2007)。以往的研究表明，消費者傾向於尋找其他消費者提供的產品資訊，認為其他消費者對產品及服務的體驗較有參考價值，也因為親朋好友是最自己最容易得知訊息的一個管道。(Cheong and Morrison, 2008; Ismagilova, Slade, Rana, and Dwivedi, 2019)，它可以降低由資訊不對稱引起的風險 (Goldsmith and Horowitz, 2006)並幫助消費者從中獲得實用價值。此外，之前的研究表明，產品資訊被認為是線上購物中功利價值的主要功利利益之一。(Chiu, Wang, Fang and Huang, 2014)。因此，本研究提出下列假說：

H5a.人際影響力調節功利價值與衝動性購買行為之間正向影響的關係

H5b.人際影響力調節享樂價值與衝動性購買行為之間正向影響的關係

3.2.4. 消費者知覺價值扮演中介角色

Kim et al. (2013)指出移動設備的“隨時隨地”交互性和易於控制使它們比計算機網站更容易使用，從而提高知覺的有效性，Strahilevitz and Myers (1998)也提出說，功利性動機能滿足消費者功能方面的需求，利用功能性屬性的提供，達到消費者解決問題的目的，或使消費者達成某項功能或任務。

而使用LINE貼圖能使消息的回覆更有效率，增強功利價值，更有研究表示消費者會通過瀏覽、搜尋來獲取符合他們期望的資訊或產品，LINE貼圖的可

攜性增強了LINE貼圖的功利價值，也讓消費者更容易發生衝動性購買行為。因此，本研究提出下列假說：

H6a.功利價值在可攜性對衝動性購買行為之影響具有中介效果

移動設備提供了獨特的個人環境，展現出獨特的特徵，以促進娛樂和刺激(Huotari and Hamari, 2017)，而不同的多媒體技術、準確的偏好預測和易於使用的行動設備，讓虛擬行動購物環境能夠有效地刺激消費者，激發他們的享受和興奮情緒(Rook, and Gardner, 1993)。因此，本研究提出下列假說：

H6b.享樂價值在可攜性對衝動性購買行為之影響具有中介效果

Heijden(2004)提到，員工認知為享樂傾向的系統，是員工在使用系統功能時可以得到樂趣(Fun)，而擁有愉快的經驗，這其中包含了在系統中建置，娛樂性的內容、華麗的圖片、主要是在聲音以及影像的觀感，屬於視覺與聽覺所引發的內心情感，而從購物環境中感受到的體驗感及享受後產生的愉悅感，會使消費者更容易發生衝動性購買行為(Y. Chen et al., 2019; Beatty and Ferrell,1998; Xiang et al.,2016)。因此，本研究提出下列假說：

H7a.享樂價值在視覺吸引力對衝動性購買行為之影響具有中介效果

Floh and Madlberger(2013)研究表明高質量的照片和視頻不僅可以幫助網站看起來更有吸引力，還可以幫助消費者瀏覽、評估、比較和選擇產品，而視覺美學可以增加消費者的線上購物價值(Cai and Xu, 2011)，也有文獻表明視覺吸引力可以引起消費者的積極態度，增加他們對功利價值的看法(Cyr et.al., 2006; Chopdar and Balakrishnan, 2020)，消費者通過瀏覽來獲取符合他們期望的資訊或產品，介面的設計與產品本身及網站購物效率的提高和流暢的運行會導致消費者在該網站上瀏覽更多產品(Sharma et al., 2006; Park et al., 2012)，進而引發衝動性購買行為。

H7b.功利價值在視覺吸引力對衝動性購買行為之影響具有中介效果

4. 研究方法

4.1 變數之操作性定義與衡量

4.1.1 可攜性

Gao.,Rau.,and Salvendy(2009)指出無處不在就意味著可攜性的特質，這使得我們能夠跨越空間和時間限制進行廣泛的覆蓋，在本研究中意旨行動設備的”隨處性”或空間和時間的組合靈活性。(Okazaki,S. and Mendez, F., 2013)，並參考Okazaki, S., and Mendez, F.(2013)對可攜性的衡量方式，並依據研究標的與特性加以修改，以李克特七點量表發展出 3 題衡量題向之量表，如表 1 所示。

4.1.2 視覺吸引力

Parboteeah et al.(2009)提出“視覺吸引力與字體和其他視覺元素(例如圖形)的展示有關，以增強網絡的整體表現力，貼圖是另類肢體語言，補充文字訊息傳遞的情感。故本研究參考Lingaard et al.(2006)的定義，將視覺吸引力定義為：「使用者所接收到貼圖後對於貼圖的色彩及生動化且個性化的視覺元素等強烈的第一印象之程度」，參考Loiacono et al.(2007)；Hall and Hanna(2004)；傅遠喻(2012)對視覺吸引力的衡量方式，並依據研究標的與特性加以修改，以李克特七點量表發展出 5 題衡量題向之量表，如表 1 所示

4.1.3. 功利價值

Overby and Lee(2006)定義功利價值，「意旨顧客在考量了產品、服務、價格等特性後，對其付出與實質利益的評估」，可知功利價值視是一種理性價值，會有一項或多項的「任務目標」，並且注重產品「功能性」(效率、易用性、節省時間)以及對自身「有效的幫助」來衡量產品價值，和享樂價值相較起來也擁有更多對產品的「認知度」。故本研究LINE貼圖的功利價值定義為：「購買貼圖時會根據自身的需求目標(即貼圖能幫我達成什麼樣的目標任務)，及貼圖的功能性對消費者幫助的意義」，因此，參考Overby and Lee(2006)；林欣怡(2014)；鮑若苡、林陽助(2016)對功利價值的衡量方式，並依據研究標的與特性加以修改，以李克特七點量表發展出 9 題衡量題向之量表，如表 1 所示。

4.1.4. 享樂價值

Overby and Lee(2006)定義享樂價值：「基於從產品或服務的感受，消費者對體驗性利益及犧牲支出的整體評價」可知享樂價值視為是一種重視「自我感受」的非理性價值，與追求「愉悅感」及「體驗感」

，並伴隨與「幻想、感覺、樂趣及符號意義」有關的元素(Hirschman and Holbrook, 1982)。故本研究LINE貼圖的享樂價值定義為：「購買貼圖時會根據當時自我的主觀感受和慾望(即想表達的情緒、情感態度及情境，偏好的貼圖類型…等)，及貼圖的功能性體驗對體驗者帶來的感覺」，因此，參考Overby and Lee (2006)；Venkatesh et al.(2012)；李家豪、郭原昌(2019)；鮑若苡、林陽助(2016)對享樂價值的衡量方式，並依據研究標的與特性加以修改，以李克特七點量表發展出 6 題衡量題向之量表，如表 1 所示。

4.1.5. 衝動性購買行為

Weinberg and Gottwald(1982)衝動性購買是看到某個產品，而不自覺地產生渴望的狀態，這個感覺是突然的、自發性的。衝動性購買行為意旨「非計畫」、「非理性」，沒有經過思考及了解而立即決定的購買決策。根據 Rook and Fisher(1995);Lin and Chen(2012);Verhagen et al.(2011)的研究，本研究將衝動性購買行為定義為「消費者不經由考慮而購買貼圖產品」，並參考 Lin and Chen(2013);Rook and Fisher(1995)對衝動性購買行為的衡量方式，並依據研究標的與特性加以修改，以李克特七點量表發展出 5 題衡量題向之量表，如表 1 所示。

4.1.6.人際影響力

人際影響力主要定義「為達到特定效果而採取行動說服，進而影響他人的決定。」個人行為的一個重要決定因素是他人的影響(Bearden et.al., 1989)，參考Pedersen(2005)對衝動性購買行為的衡量方式，並依據研究標的與特性加以修改，以李克特七點量表發展出 3 題衡量題向之量表，如表 1 所示。

表1 各項變數量表

構面	測量問項	參考文獻
可攜帶性	1.LINE 貼圖很實用，在任何地方，我可以毫無困難的使用它。 2.在家或者工作場所之外使用LINE貼圖，對我來說不會造成問題。 3.LINE貼圖很方便，因為貼圖可以任意安裝在行動裝置上。	Okazaki, S., and Mendez, F. (2013).
視覺吸引力	1.貼圖的設計能加深我對貼圖的好奇 2.LINE 貼圖所營造的感覺是我喜歡的。 3.LINE貼圖在視覺上是很吸引人的。 4.LINE貼圖在視覺上能吸引到我的注意力。 5.LINE貼圖在視覺設計上是讓人感到愉悅。	Loiacono et al.(2007)；Hall and Hanna, (2004)；傅遠喻(2012)
功利價值	1.使用LINE貼圖，讓我能快速的傳遞及回應訊息。 2.使用LINE貼圖聊天，可以不受語言不同的限制進行溝通。 3.使用LINE貼圖聊天，能減少錯字率。 4.使用LINE貼圖聊天，比文字溝通更不方便。 5.LINE貼圖的操作介面，讓我可以易於上手。 6.購買LINE貼圖是經濟又實惠的。 7.購買LINE貼圖，讓我可以擁有多種不同的回應方式，讓互動不再單調。 8.使用LINE貼圖，可以幫助我引起雙方間的話題。 9.使用LINE貼圖，可以輔佐文字無法準確表達的情緒。	Overby and Lee (2006)；林欣怡(2014)；鮑若苡、林陽助(2016)
享樂價值	1.當我使用 LINE 貼圖聊天，讓我覺得與人互動變得有趣，可以滿足我生活上的娛樂需求。 2.當我使用 LINE 貼圖聊天，貼圖可以帶給我情緒共鳴。 3.相較於其他APP的貼圖，使用LINE貼圖更能讓我樂在其中。 4.當我購買LINE貼圖後，我會期待使用LINE貼圖。 5.在貼圖小舖瀏覽LINE貼圖，可以讓我暫時遠離一切。 6.使用生動的LINE貼圖，可以使我更平易近人。	Overby and Lee (2006)；Venkatesh et al.(2012)；李家豪、郭原昌(2019)；鮑若苡、林陽助(2016)
衝動性購買行為	1.我逛貼圖小舖時，常常自然而然就買了許多貼圖，「買就對了」可以形容我購買貼圖的態度。 2.我常常連想都不用想就買下貼圖，之後再考慮後果。 3.我看到「喜歡的貼圖」，就會買下來。 4.我有時會根據當下的感受來買貼圖。 5.我有時會有一時的衝動而買下貼圖。	Lin and Chen (2013)；Rook and Fisher(1995)
人際影響力	1.幾乎我所有的朋友/同事都使用LINE貼圖。 2.幾乎所有朋友/同事都認為使用LINE貼圖回復訊息是個好主意。 3.一般來說如果我想要交朋友，我的朋友/同事會建議我嘗試使用LINE貼圖。	Pedersen(2005)

4.2. 問卷設計與資料蒐集

本研究採用問卷調查法作為研究方法，屬量化之研究，本研究為了讓內容擁有良好之效度，因此，變數的衡量都是依據相關文獻並且配合本研究的背景及目的修改而成，並採用李克特七點尺度量表作為衡量方式。

本研究設計之調查對象為台灣地區用智慧型手機使用LINE貼圖的經驗者，並設計問卷題項及配合其相關問題建構出結構式問卷，並以此做為資料收集之方式。此外，研究中問卷採取便利抽樣的發放方式，透過網路發放給用智慧型手機使用貼圖的經驗者，且預計回收350份以上有效問卷。

5. 分析

5.1. 樣本資料分析

本研究問卷採用Google表單設計而成，透過LINE群組以Facebook發放轉傳網路問卷，自110年1月27日至110年2月17日止，共回收397份樣。並檢視每份樣本刪除因反向題所造成填答謬誤之無效樣本，依此確立了本研究正式問卷之有效樣本共計354份，有效問卷回收率約為89.19%。樣本資料，如表2。其中女生填答率(60%)高於男生，年齡介於21到43歲約佔60%，教育程度大專以上約佔84%。

表2 樣本基本資料分析表

使用者基本資料		樣本數	比例%
性別	男	145	41%
	女	209	59 %
年齡	20歲以下	35	9.9%
	21~30歲	144	40.7%
	31~40歲	66	18.6%
	41~50歲	59	16.7%
	51~60歲	40	11.3%
	61歲以上	10	2.8%
教育程度	國中以下	14	4%
	高中(職)	43	12.1%
	大專院校	178	50.3%
	碩士以上	119	33.6%

5.2. 信度分析

本研究採用Cronbach's α 的數值來檢驗本研究問卷量表之信度，用意為瞭解施測對象對於問項各個構面的填答是否趨於一致，若值愈高，顯示量表內各問項的相關性愈高，意即其內部一致性愈趨於一致。根據信度分析結果每個研究變數的Cronbach's α 值皆高於0.7，顯示本研究所使用的問卷量表，具有相當程度的一致性，如表3。

表3 信度構面之信度檢測

研究構面	題項	Cronbach's α 值
可攜性	3	0.830
視覺吸引力	5	0.896
功利價值	9	0.815
享樂價值	6	0.860
人際影響力	3	0.761
衝動性購買行為	5	0.897

5.3. 相關分析

表4顯示，除可攜性及視覺吸引力與衝動性購買行為之間的關係呈現顯著低度相關，大部分變數間的相關性皆呈現顯著中度相關，視覺吸引力對知覺價值(功利價值、享樂價值)則呈現出顯著高度相關，而功利價值對享樂價值也呈現顯著高度相關，故依此相關分析結果，繼續進行迴歸分析。

表4 相關性矩陣分析表

構面	相關係數					
	A	B	C	D	E	F
A可攜性	1					
B視覺吸引力	0.656***	1				
C功利價值	0.674***	0.725***	1			
D享樂價值	0.573***	0.701***	0.770***	1		
E人際影響力	0.506***	0.545***	0.652***	0.674***	1	
F衝動性購買行為	0.295***	0.328***	0.444***	0.497***	0.458***	1

***** p-value < 0.001**

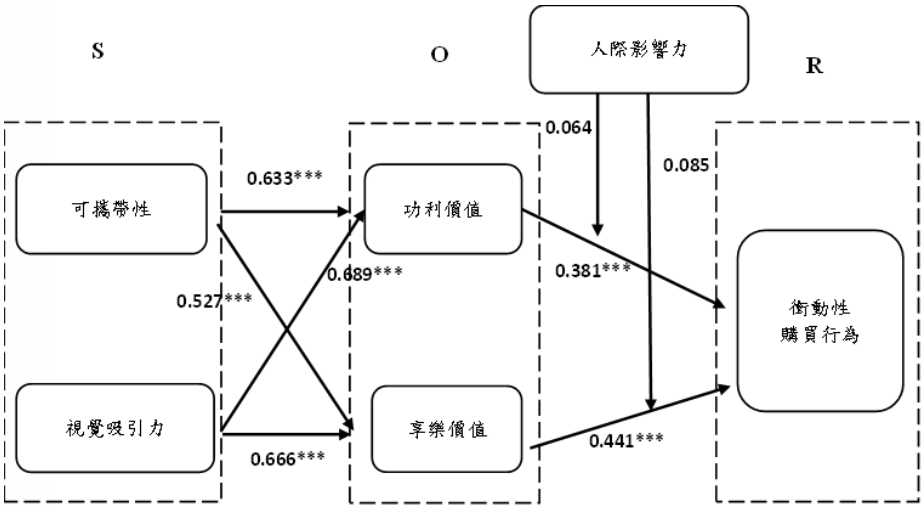

圖 2 模型分析結果

5.4. 迴歸分析

圖2顯示可攜性對功利價值正向且顯著(係數為0.633；p=0.000)，意即LINE貼圖的可攜性程度越高，就會讓使用者擁有更高的功利價值，故H1a成立；可攜性對享樂價值正向且顯著(係數為0.527；p<0.001)，意即LINE貼圖的可攜性程度越高，就會讓使用者擁有更高的享樂價值，故H1b成立；視覺吸引力對享樂價值正向且顯著(係數為0.666；p<0.001)，意即LINE貼圖的視覺吸引力程度越高，就會讓使用者擁有更高的享樂價值，故H2a成立；視覺吸引力對功利價值正向且顯著(係數為0.689；p<0.001)，意即LINE貼圖的視覺吸引力程度越高，就會讓使用者擁有更高的功利價值，故H2b成立；功利價值對衝動性購買行為正向且顯著(係數為0.381；p<0.001)，意即LINE貼圖的功利價值程度越高，就會讓使用者更容易發生衝動性購買行為，故H3成立；享樂價值對衝動性購買行為正向且顯著(係數為0.441；p<0.001)，意即LINE貼圖的享樂價值程度越高，就會讓使用者更容易發生衝動性購買行為，故H4成立。

此外，人際影響力作為調節變數，功利價值*人際影響力的交互項(係數為0.441；p>0.05)無顯著，不會調節貼圖的功利價值對衝動性購買行為的關係。故H5a：人際影響力調節功利價值與衝動性購買行為之間的關係，不成立；享樂價值*人際影響力的交互項(係數為0.085；p>0.05)無顯著，不會調節貼圖的享樂價值對衝動性購買行為的關係。故H5b：人際影響力調節享樂價值與衝動性購買行為之間的關係，不成立。

這可能是因為研究主題的不同，在購物平台上種類多樣化，資訊量過於龐大，確實會因聽從他人的意見及推薦來選擇自己所需的商品，但在貼圖的主題類型上，因存在消費者個人偏好問題，屬於較主觀的思考邏輯，較不會因為聽取他人意見或是推薦，而

對該貼圖產生衝動性購買行為。

再者，以知覺價值(功利價值、享樂價值)為中介變數，探討環境刺激因素(可攜性、視覺吸引力)對衝動性購買行為的影響，結果證實環境刺激因素(可攜性、視覺吸引力)可透過(功利價值、享樂價值)的中介效果，對衝動性購買行為產生顯著影響，此外，再中介變數被控制的情況下，環境刺激因素(可攜性、視覺吸引力)對衝動性購買行為的影響程度為0(即不顯著之意)，具有完全中介效果，因此假設H6a、H6b、H7a、H7b皆成立。

6. 結論與建議

6.1 研究結論

透過問卷調查分析，結果顯示多數使用者對LINE貼圖環境刺激因素(可攜性、視覺吸引力)、知覺價值(功利價值、享樂價值)、人際影響力都有頗高的認知價值，對於衝動性購買行為也有一定的認知價值，而年齡落於31-40歲的這一群LINE貼圖使用者是較活躍的一群，並且一天平均使用LINE貼圖的頻率高達21次以上多數，代表著貼圖已融入消費者的生活中。

而透過一連串的迴歸分析結果顯示，LINE貼圖的環境刺激因素(可攜性、視覺吸引力)會正向顯著影響消費者內在心理層面的知覺價值(功利價值、享樂價值)的感受，進而正向顯著影響消費者的衝動性購買行為，另外，人際影響力雖然對知覺價值及衝動性購買行為個別有顯著影響，但因LINE貼圖存在個人偏好問題較無法被他人左右，所以人際影響力在知覺價值與衝動性購買行為之間並無調解作用。

6.2. 研究貢獻

(1)以環境心理學S-O-R理論應用於LINE貼圖

S-O-R理論框架是行動商務衝動性購買研究中常用的理論(Yang et al., 2021; Zhang et al., 2020; Zheng et al., 2019)，該模型被廣泛用於研究環境、情緒和行為之間的關係，也為不同背景的衝動性購買行為奠定了基礎。過去研究LINE貼圖的議題相當多元化，但許多相關研究都是為了要挖掘LINE貼圖本身的商品價值(戴綺瑩、王藍亭，2019；蔡語慧、高嘉懌，2020；王魁閎，2019；張玉琳與李秋滿，2014)；衝動性購買行為則是以網路平台、行動電商平台、實體店面相關研究居多(Yang et al., 2021; Parboteeah et al., 2009; Chen et al., 2020; Sihombing et al., 2020; Wells et al., 2011; Zhang et al., 2020)，本研究認為使用LINE的使用者亦會對LINE貼圖產生衝動性購買行為，但過去鮮少有研究探討LINE貼圖的衝動性購買行為，著眼於近年LINE已成為大眾社群的主流之一，再加上疫情影響會使用LINE的使用族群已非學生等年輕族群，將抽樣對象擴及全臺灣不同職業別、年齡層、使用LINE貼圖的頻率，在職業別的部分以學生、服務業族群為主；在年齡層的部分以21-30歲為主最多；使用LINE貼圖的頻率以使用21次以上居多，，並將環境刺激因素(可攜性、視覺吸引力)做為主要核心之一，帶入至LINE貼圖背景之中。

再者由於價值是因應體驗所產生(Gummerus, 2013)，而在消費者的LINE貼圖衝動購買行為中，本研究分析結果：環境刺激因素(可攜性、視覺吸引力)對於知覺價值(功利價值、享樂價值)對衝動購買行為皆具有中介效果， LINE貼圖的知覺價值(功利價值、享樂價值)皆能激發消費者對貼圖的衝動性購買行為，換言之，越能滿足使用者功利與享樂需求的貼圖平臺，以及越能建立消費者的情境式的體驗而產生社交連結的貼圖平臺，那麼衝動性購買的誘因也會越大，此研究也更有助於了解LINE貼圖的使用者會因為何種因素，而產生衝動性購買行為。

(2)探討人際影響力對於LINE貼圖的影響

本研究參考行動商務消費者知覺價值與衝動性購買行為：社會影響的調節作用(Yang et al., 2021)的研究，以LINE貼圖作為研究背景，並以人際關係作為調節變數，進一步了解人際影響力對LINE貼圖衝動性購買行為得影響，而本研究的問卷結果揭示了人際影響力對LINE貼圖衝動性購買行為並不具有調節作用，原因可能是因為人際影響力是達到特定效果而採取行動說服、說服或影響他人的影響(Bearden et.al., 1989)，但LINE貼圖存在消費者個人偏好問題，屬於較主觀的思考邏輯，較不會因為聽取他人意見或是推薦，而對該貼圖產生衝動性購買行為。

6.3. 管理意涵

(1)在創作的方面策略建議：

一張貼圖勝過千言萬語。從LINE貼圖的知覺價值可發現出影響LINE貼圖購買下載及使用頻率，最重要的元素為貼圖自身的「視覺吸引力」、貼圖的「功利價值」以及這過程中能帶給消費者的「享樂價值」，意旨貼圖本身的視覺設計能不能吸引到消費者的眼球，來增加消費者的好奇心，而讓消費者去預覽LINE貼圖的「功能性」能否幫助自己完成目標，以及使用過程中的「娛樂感」，結果顯示越有「視覺設

計感的功能性貼圖」越容易在使用者間流傳，而貼圖所帶來情境式體驗的享樂感，能進而促使消費者下載、創造熱銷商機。

綜合本研究的分析結果可以發現：貼圖本身的實用性(可以快速回應且明確的傳遞自身的情感、比起單一化的文字，貼圖不同的回應方式，使得彼此間互動不再單調，更容易擁有良好的社交)能夠為消費者帶來更多的功利價值，再加上LINE貼圖豐富、有趣、生動、個性化的視覺效果，進一步激發消費者對LINE貼圖的情感反應和興趣，讓互動變得有趣之外，也使得人與人之間產生連結，更引起消費者情緒的共鳴，讓消費者擁有情境式的體驗，種種因素提升消費者的享樂價值，也增進消費者想衝動性購買的意願，然而消費者對於LINE貼圖的功利價值多認為擁有多元的回應方式能快速回應訊息及能輔佐文字無法準確表達的情緒這二項為問項最高分；LINE貼圖的享樂價值則認為使用LINE貼圖能帶來情緒上的共鳴，代表能表達出各類情緒的貼圖更受消費這喜愛。

再者LINE貼圖又分成「表情」、「行為情境」及「問候語」三大類，這些貼圖藉由淺顯易懂的圖文，方便讓人們相互交流及互動。另外，貼圖設計可以多參考身邊的人事物，並以網路上火紅、能引起使用者共鳴的元素做發想，貼圖的創作不易，非但要角色造型符合大眾喜好，其表達的方式更要具有特色或是與時事相連，才能脫穎而出並吸引大眾。而貼圖汰換率極高，有著極多的選擇使得貼圖要維持人氣並不容易。因此，要能保持貼圖的創作品質及持續推出創新的貼圖，才能穩定客源。而了解支持自己的消費者以及會消費此類創作的消費者的喜好即非常重要。

(2)在行銷的方面策略建議：

根據結果顯示LINE貼圖的視覺設計容易吸引消費者的目光，也有助於建立雙方的社交頻率滿足生活上的娛樂需求，但在行銷LINE貼圖的部分略顯不足，故建議除了在LINE小舖讓搜尋及分類更貼近用戶的使用習慣、更直覺簡單之外，應當增加LINE貼圖的曝光度，Liang(2012)研究表示，消費者有較高的產品知識，會有較高的衝動購買行為，而投入廣告能增加消費者的產品知識，因此貼圖販售商可以增加投入多媒體廣告，將新貼圖外觀設計與構想透過廣告的方式增加曝光率，增加消費者對新貼圖的知識及好奇心，視覺吸引力更能擄獲消費者的眼球，進而產生想衝動性購買的心思，也能增加貼圖的知名度。

(3)在價格的方面策略建議：

「購買LINE貼圖是經濟又實惠的」平均值為4.80，低於功利價值的平均5.76，代表LINE貼圖的價格對於部分消費者而言還是偏貴，雖說有免費的貼圖可供消費者使用但畢竟有限，而提供的折扣之貼圖也較少，在根據學者Piron(1991)的研究指出商品的降價或是促銷的活動，消費者越會產生衝動性購買行為，因此在LINE貼圖的價格上可以做一些彈性的變化，好比在固定節日降價、也可讓LINE貼圖的忠實顧客有一些優惠的方案、又或者爭對消費者的偏好進行差異化的優惠活動。

6.4. 研究限制與未來建議

本研究在LINE貼圖的消費者樣本中，年齡介於21到30歲之間人數最多，且職業以學生、服務業為主，所以不能代表整個LINE貼圖的消費顧客群，在環境刺激因素的部分，因考慮到時間與填答者的疲倦感，本研究僅探討可攜性及視覺吸引力二種環境刺激因素，而過去文獻多以探討移動商務的可攜性及界面設計居多，較少有關於貼圖本身的文獻，期待未來能有更多相關文獻能參考，也期盼未來其他研究者對於LINE貼圖能加入更多不同的環境刺激因素來做更加廣泛的研究。

本研究雖驗證了大部分的研究假設具有正向顯著的影響，然而影響LINE貼圖衝動性購買行為其背後更細微的成因亦值得探究，建議日後研究者或可輔以質性研究，透過個案訪談的方式，了解不同族群對LINE貼圖的偏好及何種環境刺激因素會導致消費者對貼圖產生衝動性購買行為，更深入的探討使用者的使用經驗，用以彌補量化研究的不足及侷限。

References

Adomaviciute, K. (2013). Relationship between utilitarian and hedonic consumer behavior and socially responsible consumption. Journal of Economics and Management, 18(4), 754-760.

Anwar, A., Thongpapanl, N., & Ashraf, A. R. (2021). Strategic imperatives of mobile commerce in developing countries: the influence of consumer innovativeness, ubiquity, perceived value, risk, and cost on usage. Journal of Strategic Marketing, 29(8), 722-742.

Arnold, M. J., & Reynolds, K. E. (2003). Hedonic shopping motivations. Journal of retailing, 79(2), 77-95.

Ashraf, A. R., Thongpapanl, N., Menguc, B., & Northey, G. (2017). The role of m-commerce readiness in emerging and developed markets. Journal of International Marketing, 25(2), 25-51.

Bandura, A. (1977). Self-efficacy: toward a unifying theory of behavioral change. Psychological Review, 84, 191-215.

Bearden, W. O., Netemeyer, R. C. & Teel, J. E. (1989). Measurement of consumer susceptibility to interpersonal influence. The Journal of Consumer Research, 15(4), 473-81.

Beatty, S. E., & Ferrell, M. E. (1998). Impulse buying: Modeling its precursors. Journal of retailing, 74(2), 169-191.

Caal. (2003). Effects of Media Formats on Emotions and Impulse Buying Intent. Journal of Information Technology,18(4), 247-266.

Cai, S., & Xu, Y. (2011). Designing not just for pleasure: effects of web site aesthetics on consumer shopping value. International Journal of Electronic Commerce, 15(4), 159-188.

Carpenter, J. M. (2008). Consumer shopping value, satisfaction and loyalty in discount retailing. Journal of retailing and consumer services, 15(5), 358-363.

Chan, T. K., Cheung, C. M., & Lee, Z. W. (2017). The state of online impulse-buying research: A literature analysis. Journal of Information and Management, 54(2), 204-217.

Chang, H. H., & Chen, S. W. (2008). The impact of online store environment cues on purchase intention: Trust and perceived risk as a mediator. Online information review, 32(6), 818-841.

Chen, Y., Li, D., & Zhao, Z. (2020). Research on Product Recommendation and Consumer Impulsive Purchase Under Social Commerce Platform—Based on S-0-R Model. Atlantis Press, 215-223.

Cheong, H. J., & Morrison, M. A. (2008). Consumers' reliance on product information and recommendations found in UGC. Journal of interactive advertising, 8(2), 38-49.

Chiu, C. M., Wang, E. T., Fang, Y. H., & Huang, H. Y. (2014). Understanding customers' repeat purchase intentions in B2C e-commerce: the roles of utilitarian value, hedonic value and perceived risk. Information Systems Journal, 24(1), 85-114.

Cho, W. C., Lee, K. Y., & Yang, S. B. (2019). What makes you feel attached to smartwatches? The stimulus–organism–response (S–O–R) perspectives. Journal of Information Technology and People,32(2), 319-343.

Chopdar, P. K., & Balakrishnan, J. (2020). Consumers response towards mobile commerce applications: SOR approach. International Journal of Information Management, 53, 102106.

Cobb, C. J., & Hoyer, W. D. (1986). Planned versus impulse purchase behavior. Journal of Retailing, 62(4), 384–499.

Cyr, D., Head, M., & Ivanov, A. (2006). Design aesthetics leading to m-loyalty in mobile commerce. Journal of Information and management, 43(8), 950-963.

Parboteeah, D. V., Valacich, J. S., & Wells, J. D. (2008) The Influence of Website Characteristics on a Consumer's Urge to Buy Impulsively. Journal of Information Systems Research, 20(1), 60-78.

Davis, F. D. (1989). Perceived usefulness, perceived ease of use, and user acceptance of information technology. MIS quarterly, 319-340.

Feng Yang a, Jing Tang b, Jinqi Men b, Xiabing Zheng(2021). Consumer perceived value and impulse buying behavior on mobile commerce: The moderating effect of social influence, Journal of Retailing and Consumer Services, 63.

Floh, A., Madlberger, M. (2013). The role of atmospheric cues in online impulse-buying behavior. Journal of Electronic Commerce Research and Applications, 12(6), 425-439.

Gao, Q., Rau, P. L. P., & Salvendy, G. (2009). Perception of interactivity: Affects of four key variables in mobile advertising. International Journal of Human–Computer Interaction, 25(6), 479–505.

Goldsmith, R. E., & Horowitz, D. (2006). Measuring

motivations for online opinion seeking. Journal of interactive advertising, 6(2), 2-14.

Gummerus, J. (2013). Value creation processes & value outcomes in marketing theory: strangers or siblings? Journal of Marketing Theory, 13(1), 19-46.

Heijden, H. V. D. (2004), User acceptance of hedonic information systems. Management Information Systems Quarterly, 28(4), 695-704.

Hirschman, E. C. and Holbrook, M. B. (1982). Hedonic consumption: emerging concepts, methods & propositions. Journal of Marketing, 46(3), 92-101.

Hoffman, D. L., & Novak, T. P. (1996). Marketing in hypermedia computer-mediated environments: Conceptual foundations. The Journal of Marketing, 50-68.

Holbrook, M. & Hirschman, E. (1982). The Experiential aspects of consumption: consumer fantasies, feeling and fun. Journal of consumer research, 9(2), 132-140.

Hsieh, S. H., Lee, C. T., & Tseng, T. H. (2021). Branded app atmospherics: examining the effect of pleasure-arousal-dominance in brand relationship building. Journal of Service Management, 60.

Hubert, M., Blut, M., Brock, C., Backhaus, C., & Eberhardt, T. (2017). Acceptance of smartphone–based mobile shopping: Mobile benefits, customer characteristics, perceived risks, and the impact of application context. Psychology and Marketing,34(2), 175-194.

Huotari, K., & Hamari, J. (2017). A definition for gamification: anchoring gamification in the service marketing. International Journal of Internet Business, 27(1), 21-31.

Ismagilova, E., Rana, N., Slade, E., & Dwivedi, Y. (2019). A Review and Weight Analysis of Factors Affecting Helpfulness of Electronic Word-of-Mouth Communications. In Academy of Marketing Science Annual Conference, 469-479.

Jacoby, J. (2002). Stimulus–organism–response reconsidered: an evolutionary step in modeling (consumer) behavior. Journal of consumer psychology,12(1), 51-57.

Jiang, Z., Chan, J., Tan, B. C., & Chua, W. S. (2010). Effects of interactivity on website involvement and purchase intention. Journal of the Association for Information Systems, 11(1), 1.

Junglas, I., & Watson, R. T. (2006). The u-constructs: four information drives. Journal of Association for Information systems, 17(1), 26.

Kim, C., Mirusmonov, M., & Lee, I. (2010). An empirical examination of factors influencing the intention to use mobile payment. Computers in human behavior, 26(3), 310-322.

Kim, E., Lin, J. S., & Sung, Y. (2013). To app or not to app: Engaging consumers via branded mobile apps. Journal of Interactive Advertising, 13(1), 53-65.

Knutson, J. F. (1998). The Effect of the User Interface Design on Adoption of New Technology Dissertation Abstracts International: Section B: The Sciences and Engineering 59(3-B),1399.

Koenig-Lewis, N., Marquet, M., Palmer, A., & Zhao, A. L. (2015). Enjoyment and social influence: predicting mobile payment adoption. The Service Industries Journal, 35(10), 537-554.

Kukar-Kinney, M., Ridgway, N. M., & Monroe, K. B. (2009). The relationship between consumers' tendencies to buy compulsively and their motivations to shop and buy on the Internet. Journal of Retailing, 85(3), 298-307.

Law, D. ,Wong, C. & Yip, J. (2012). How does visual merchandising affect consumer affective response? An intimate apparel experience. European Journal of Marketing, 46, 112-133

Li, Y. M., & Yeh, Y. S. (2010). Increasing trust in mobile commerce through design aesthetics. Computers in Human Behavior, 26(4), 673-684.

Liang, Y. P. (2012). The Relationship between Consumer Product Involvement, Product Knowledge and Impulsive Buying Behavior. Journal of Social and Behavioral Sciences, 57, 325-330.

Lin, Y. H., & Chen, C. F. (2013). Passengers' shopping motivations and commercial activities at airports–The moderating effects of time pressure and impulse buying tendency. Journal of Tourism Management, 36, 426-434.

Lindgaard, G., Fernandes, G., Duduk, C., & Brown, J. (2006). Attention web designers: You have 50 milliseconds to make a good first impression!, Journal of Behaviour and Information Technology, 25(2), 115-126.

Loiacono, E. T., Watson, R. T., & Goodhue, D. L. (2007). WebQual: An instrument for consumer evaluation of web sites. International Journal of electronic commerce, 11(3), 51-87.

Mehrabian, A., Russell, J. A. (1974). An Approach to Environmental Psychology. The MIT Press.

Merhi, M. I. (2016). Towards a framework for online game adoption. Journal of Computers in Human Behavior, 60, 253-263.

Okazaki, S., & Mendez, F. (2013). Exploring convenience in mobile commerce: Moderating effects of gender. Journal of Computers in Human Behavior, 29(3), 1234-1242.

Olsen, S. O., & Skallerud, K. (2011). Retail attributes' differential effects on utilitarian versus hedonic shopping value. Journal of Consumer Marketing,28(7), 532-539.

Overby, J. W., & Lee, E. J. (2006). The effects of utilitarian and hedonic online shopping value on consumer preference and intentions. Journal of Business Research, 59,10-11.

Parboteeah, D. V., Valacich, J. S., & Wells, J. D. (2009). The influence of website characteristics on a consumer's urge to buy impulsively. Journal of Information Systems Research,20(1), 60-78.

Park, E. J., Kim, E. Y., Funches, V. M., & Foxx, W. (2012). Apparel product attributes, web browsing, and e-impulse buying on shopping websites. Journal of Business Research, 65(11), 1583-1589.

Piron, F. (1991). Defining impulse purchasing. ACR North American Advances, 18, 509-514.

Rook, D. W., & Fisher, R. J. (1995). Normative influences on impulsive buying behavior. Journal of consumer research, 22(3), 305-313.

Rook, D. W., & Gardner, M. P. (1993). In the mood: Impulse buying's affective antecedents. Journal of Research in consumer behavior, 6(7), 1-28.

Ryu, K., Han, H., & Jang, S. C. (2010). Relationships among hedonic and utilitarian values, satisfaction and behavioral intentions in the fast-casual restaurant industry. International Journal of Contemporary Hospitality Management, 22(3), 416-432.

Sharma, P., Sivakumaran, B., & Marshall, R. (2010). Impulse buying and variety seeking: A trait-correlates perspective. Journal of Business Research, 63(3), 276-283.

Sharma, P., Sivakumaran, B., Marshall, R. (2006). Investigating impulse buying and variety seeking: toward a general theory of hedonic purchase behaviors. 33(1), 388-389.

Sheng, M. L., & Teo, T. S. (2012). Product attributes and brand equity in the mobile domain: The mediating role of customer experience. International journal of information management, 32(2), 139-146.

Short, J., Williams, E., & Christie, B. (1976). The social psychology of telecommunications. 195.

Sihombing, E. S., Budi, I., & Munajat, Q. (2020). Factors affecting the urge of impulsive buying on social commerce Instagram. International Journal of Internet Marketing and Advertising, 14(3), 236-257.

Stern, H. (1962). The significance of impulse buying today. Journal of Marketing, 26(2), 59-62.

Strahilevitz, M. A. & Myers, J. G. (1998). Donations to Charity as Purchase Incentives: How well They Work May Depend on What You Are Trying to Sell. Journal of Consumer Research, 24, 434-446.

To, P. L., Liao, C., & Lin, T. H. (2007). Shopping motivations on Internet: A study based on utilitarian and hedonic value. Journal of Technovation, 27(12), 774-787.

Van de Ven, N., & Zeelenberg, M. (2011). Regret aversion and the reluctance to exchange lottery tickets. Journal of Economic Psychology, 32(1), 194-200.

Van der Heijden, H. (2003). Factors influencing the usage of websites: the case of a generic portal in The Netherlands. Information and management, 40(6), 541-549.

Van der Heijden, H., & Verhagen, T. (2004). Online store image: conceptual foundations and empirical measurement. Journal of Information and Management, 41(5), 609-617.

Venkatesh, V., Thong, J. Y. L., & Xu, X., (2012). Consumer acceptance and use of information technology: extending the unified theory of acceptance and use of technology. MIS Quarterly, 36(1), 157-178.

Verhagen, T., & Van Dolen, W. (2011). The influence of online store beliefs on consumer online impulse buying: A model and empiricalheng application. Journal of Information and Management, 48(8), 320-327.

Wang, Y. J., Minor, M. S., & Wei, J. (2011). A Aesthetics and the online shopping environment: Understanding consumer responses. Journal of Retailing, 87(1), 46-58.

Zhang, W., Leng, X., & Liu, S. (2020), Research on mobile impulse purchase intention in the perspective of system users during COVID-19. Personal and ubiquitous computing, 1-9.

Weinberg, P., & Gottwald, W. (1982). Impulsive consumer buying as a result of emotions. Journal of Business research, 10(1), 43-57.

Welles, G. (1986). We're in the habit of impulsive buying. USA today daily, 1(21), 53-67.

Wells, Parboteeah, & Valacich. (2011), Online impulse buying: understanding the interplay between consumer impulsiveness and website quality. Journal of the Association for Information Systems, 12(1), 32-56.

Xiang, L., Zheng, X., Lee, M. K., & Zhao, D. (2016). Exploring consumers' impulse buying behavior on social commerce platform: The role of parasocial interaction. International journal of information management, 36(3), 333-347.

Yang, F., Tang, J., Men, J., & Zheng, X. (2021). Consumer perceived value and impulse buying behavior on mobile commerce: The moderating effect of social influence. Journal of Retailing and Consumer Services, 63, 102683.

Yoon, S. O., Suk, K., Lee, S. M., & Park, E. Y. (2011). To seek variety or uniformity: The role of culture in consumers' choice in a group setting. Marketing Letters, 22(1), 49-64.

Zhang, H., Lu, Y., Gupta, S., & Zhao, L. (2014). What motivates customers to participate in social commerce? The impact of technological environments and virtual customer experiences. Information and Management,51(8), 1017-1030.

Zhang, P., & Li, N. (2004). Love at first sight or sustained effect? The role of perceived affective quality on users' cognitive reactions to information technology.

Zheng, X., Men, J., Yang, F., & Gong, X. (2019). Understanding impulse buying in mobile commerce: An investigation into hedonic and utilitarian browsing. International Journal of Information Management, 48, 151-160.

作者簡介

Luo-Ling Wu received her Bachelor's degree and Master's degree in Business Administration from Dayeh University, Taiwan, in 2020 and 2022, respectively.

Ching-Chih Tseng is a Professor in the Department of Business Administration at Dayeh University, Taiwan. He received his Bachelor's degree and Master's degree in Industrial Management from National Cheng Kung University, Taiwan, in 1983 and 1985, respectively, as well as his PhD degree in Industrial Engineering and Management from Tokyo Institute of Technology in 1996. His research activities include service quality management, project management, quality function deployment and his articles are published in European Journal of Operational Research, Japanese Society of Operational Research, Journal of the Chinese Institute of Industrial Engineers, Journal of Industrial and Production Engineering, Journal of Science and Engineering Technology, and Research in Transportation Business and Management.

INSTRUCTIONS TO AUTHORS

Submission of papers

The International Journal of Systematic Innovation is a refereed journal publishing original papers four times a year in all areas of SI. Papers for publication should be submitted online to the IJoSI website (http://www.ijosi.org) In order to preserve the anonymity of authorship, authors shall prepare two files (in MS Word format or PDF) for each submission. The first file is the electronic copy of the paper without author's (authors') name(s) and affiliation(s). The second file contains the author's (authors') name(s), affiliation(s), and email address(es) on a single page. Since the Journal is blind refereed, authors should not include any reference to themselves, their affiliations or their sponsorships in the body of the paper or on figures and computer outputs. Credits and acknowledgement can be given in the final accepted version of the paper.

Editorial policy

Submission of a paper implies that it has neither been published previously nor submitted for publication elsewhere. After the paper has been accepted, the corresponding author will be responsible for page formatting, page proof and signing off for printing on behalf of other co-authors. The corresponding author will receive one hardcopy issue in which the paper is published free of charge.

Manuscript preparation

The following points should be observed when preparing a manuscript besides being consistent in style, spelling, and the use of abbreviations. Authors are encouraged to download manuscript template from the IJoSI website, http://www.ijosi.org.

1. *Language.* Paper should be written in English except in some special issues where Chinese maybe acceptable. Each paper should contain an abstract not exceeding 200 words. In addition, three to five keywords should be provided.
2. *Manuscripts.* Paper should be typed, single-column, double-spaced, on standard white paper margins: top = 25mm, bottom = 30mm, side = 20mm. (The format of the final paper prints will have the similar format except that double-column and single space will be used.)
3. *Title and Author.* The title should be concise, informative, and it should appear on top of the first page of the paper in capital letters. Author information should not appear on the title page; it should be provided on a separate information sheet that contains the title, the author's (authors') name(s), affiliation(s), e-mail address(es).
4. *Headings.* Section headings as well as headings for subsections should start front the left-hand margin.
5. *Mathematical Expressions.* All mathematical expressions should be typed using Equation Editor of MS Word. Numbers in parenthesis shall be provided for equations or other mathematical expressions that are referred to in the paper and be aligned to the right margin of the page.
6. *Tables and Figures.* Once a paper is accepted, the corresponding author should promptly supply original copies of all drawings and/or tables. They must be clear for printing. All should come with proper numbering, titles, and descriptive captions. Figure (or table) numbering and its subsequent caption must be below the figure (or table) itself and as typed as the text.
7. *References.* Display only those references cited in the text. References should be listed and sequenced alphabetically by the surname of the first author at the end of the paper. For example:

Altshuller, G. (1998). *40 Principles: TRIZ Keys to Technical Innovation*, Technical Innovation Center.

Sheu, D. & Lee, H. (2011). A Proposed Process for Systematic Innovation, International Journal of Production Research, Vol. 49, No. 3, 2011, 847-868.

The International Journal of Systematic Innovation
Journal Order Form

Organization Or Individual Name	
Postal address for delivery	
Person to contact	Name: e-mail: Position: School/Company:
Order Information	**I would like to order ___ copy(ies) of the** *International Journal of Systematic Innovation*: **Period Start: 1st/ 2nd half ____, Year:_____(Starting 2010)** **Period End : 1st/ 2nd half ____, Year:** **Price:** **Institutions: US $150 (yearly) / NT 4,500 (In Taiwan only)** **Individuals: US $50 (yearly) / NT 1500 (In Taiwan only)** (Local postage included. International postage extra) **E-mail to**: IJoSI@systematic-innovation.org or fax: +886-3-572-3210 Air mail desired ☐ (If checked, we will quote the additional cost for your consent)
Total amount due	**US$**

Payment Methods:

1. **Credit Card (Fill up the following information and e-mail/ facsimile this form to The Journal office indicated below)**
2. **Bank transfer**
3. **Account:** The Society of Systematic Innovation
4. **Bank Name:** Mega International Commercial BANK
5. **Account No:** 020-53-144-930
6. **SWIFT Code:** ICBCTWTP020
7. **Bank code**：017-0206
8. **Bank Address:** No. 1, Xin'an Rd., East Dist., Hsinchu City 300, Taiwan (R.O.C.)

VISA / Master/ JCB/ AMERICAN Cardholder Authorization for Journal Order

Card Holder Information

Card Holder Name	(as it appears on card)				
Full Name (Last, First Middle)					
Expiration Date	/ (month / year)	Card Type	☐ VISA ☐ MASTER ☐ JCB		
Card Number	☐☐☐☐-☐☐☐☐-☐☐☐☐-☐☐☐☐		Security Code	☐☐☐ 	
Amount Authorized		Special Messages			
Full Address (Incl. Street, City, State, Country and Postal code)					

Please Sign your name here _____ (same as the signature on your card)

The Society of Systematic Innovation
6 F, #352, Sec. 2, Guanfu Rd,
Hsinchu, Taiwan, 30071, R.O.C.