





# Managing competitive advantage through technology and innovation systems and its impacts on service delivery within the Kaohsiung City Government in Taiwan

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**Background:** Technology and innovation were envisaged as the key to competitive advantages and have become a hallmark of business life worldwide. Without technologies and invention practically, no organisation can survive. Thus, this required a clear understanding of how managing innovation and technology influenced business survival. This was much more explicit in an unprecedented and unavoidable competition in the business world environment, and particularly in the local government authorities' context, it can be of great significance.

**Objectives:** The main objective of this article was to provide a framework for assessing the effects of managing competitive advantage through technology and innovation in the context of metropolitan cities. This study also helped to provide an understanding of how technological innovation factors affected the performance of organisation effectiveness.

**Methodology:** The methodology used in this study was mainly the secondary data analysis. A complete and thoroughly secondary data analysis process has been utilised as a research design and approach to complete this research work. This section rationalised the selection of the preferred methodology, dealt with data collection and data analysis and covered how data originated from secondary data sources.

**Results:** One of the fundamental contributions of this investigation has been the development of a pool of valuable data in relation to managing technology and innovation for sustainable competitive advantage in the City Government of Taiwan as public sector. Furthermore and based on the results of reviewing and evaluating the relevant literature and theories taken together, this study has led to the development and proposal of a model, the conceptual framework. This developed conceptual framework reflected the bond between managing competitive advantage techniques through technology and innovation and business performances, which can be applied to different business sectors of the central government. The concept can also be applied to different businesses or to different countries confronted by similar challenges and issues of managing technology and innovation.

**Conclusion:** This article posited the importance of managing competitive advantage through technology and innovation, particularly as an essential ingredient of competitive advantage for the local government authorities or metropolitans and municipalities.

**Keywords:** innovation; technology; technological innovation capabilities; organisational performance; competitive advantage; Taiwan.

## Introduction

Owing to technical advancement and transformation in various business sectors, the idea of competitive advantage has evolved over time (Feng et al. 2020). Organisation management and the potential for enough services can be achieved by developments in an effortless and viable manner. The use of technology and innovation will help the organisation adapt to the dynamic condition and improve its competitive position. Furthermore, it enables the organisation to make business esteem; it would be less demanding for them to offer quality merchandise and enterprises, increment efficiency and amplify benefits (Wei, Feng & Zhang 2017). Although technology advancement is a phase, the redesign of innovation capacities is an ongoing task for the enterprise. This requires a complex strategy and analysis development of capacity-enhancing or capacity-growing services. The emphasis is on the use and improvement of technology, product, process, expertise, practice and organisation. Eventually, these considerations will decide whether clients/

customers are happy with the services rendered by the firms (Satalkina & Steiner 2020; Van der Loos, Negro & Hekker 2020; Yu et al. 2017). Competition in the commercial world is inevitable, for that each exertion is essential to dependably recognise, comprehend what is going on in the marketplace and what client needs and comprehend the adjustments in the business condition to rival others (Fagerberg 2018; Yu, Zhang & Liu 2019).

Therefore, an attempt should be made on a consistent basis to understand when and how to deal with issues of asset acquisition, which attracts the competition and creates a competitive advantage. One solution to winning competition by using product creativity is the preparation of new products along with competition from rivals (Fukuda 2020). Competition involves identifying markets to find and serve clients by offering new products or services (Hinings, Gegenhuber & Greenwood et al. 2018). However, it is paramount to holding competition in mind and the overall aim of acquiring a core market position and winning competitors' fights for the primary objective of fulfilling consumer requirements (Rachinger et al. 2019). Subsequently, it tends to be utilised as a competitive advantage for a business.

This knowledge would help public authorities, educational agencies, local governments or metropolitan cities and municipalities in their attempts to recognise the existing state of technology and innovation management for sustainable competitive advantage. In turn, local authorities or regional cities and countries will be able to use this knowledge base to better understand their own needs in partnerships. This would allow them to leverage technology and innovation for a sustainable competitive advantage and to make informed decisions to invest in research and development (R&D) and purchasing policies and practices (Tshabalala & Khoza 2019b; Zhu & Lin 2018).

The scope of this study is limited to managing competitive advantage through technology and innovation and its impacts on service delivery at Kaohsiung City Government, Taiwan. This study also shed much light on how managing innovation and technology influences business survival in an unprecedented and unavoidable competition in the business world environment. This is also true in the context of local government authorities or metropolitan cities and municipalities. From a research perspective, restricting the study to Kaohsiung City Government, Taiwan, minimises the scope of subject area by narrowing it within manageable terms, particularly that Kaohsiung City is the second largest city in Taiwan, and moreover, Kaohsiung City is an industrial harbour for Taiwan. The main purpose of this research study is to provide a framework for assessing the effects of managing competitive advantage through technology and innovation in the context of metropolitan cities. This study also helps to provide an understanding of how technological innovation factors affect the performance of organisation effectiveness.

## Background information

### Managing technology and innovation: An overview

In contemporary business practices, globalisation led to significant shifts. Recently, as a result of ongoing shifts in global markets, technical status has been altered. The rising need and value of technical business operations have prompted interest in fundamental technical and innovation thinking. Several concepts have been developed, for instance, the integrated technology and innovation management concepts that stem from (Bleicher 1991) integrated management theory (Tschirky 2003). Technology management itself acclimates these current environmental factors through a transition from technology management to the management of existing and already developed technology-based firms. This means that technology management is not portrayed as the connection between science and technology (S&T) and management. In comparison, a missed link should be considered, as an important part 'within' the management, an activity 'outside' the management, technology and innovation management. This move, which essentially happens within large multinational companies, merges the extent of the 'Integrated Technology and Innovation Management' in substantial and new technological innovation-based firms, in light of the fact that in new technology-based firms (NTBF), S&T and management are naturally firmly connected (Cavalcante 2013).

The competitive advantage of an organisation is an essential instrument for businesses in market competition and the fundamental technological competencies of entities, like city government or metropolitan cities and municipalities, are believed to be significant tools for institutional development. In recent times, more innovation accomplishments and advanced innovation capability have enabled organisations to gather more specialists and innovative ideas, which are new catalysts for economic growth and development path for any organisation. Similarly, the survival and development of an organisation cannot be detached from the influence emanating from both national and international environments (OECD 1999; Feng et al. 2020). Organisations, including city governments, metropolitan cities and municipalities, anticipate having sustainable competitive advantages and this can be achieved through managing technology and innovation. Notwithstanding the above, only limited organisations can actualise this. Furthermore, with the transformation taking place in societies, the sustainable competitive development of organisations is confronting a tough test (Sutopo, Astuti & Suryandari 2019). The fundamental competency of the city government, metropolitan city or municipalities is the essence competitiveness of such organisations in the market, especially when city governments have to compete with private sectors. Currently, only a few city governments, metropolitan cities and municipalities are in the leading position, in terms of having competitive advantages as a result of technology and innovation. Only those organisations

including city governments that can seize the opportunity affect transformations of the management system, institute cutting-edge technology first and conduct innovation research constantly, which can guarantee certain competitive advantages in the long-standing development process (Saura, Debasa & Reyes-Menendez 2019; Sutopo et al. 2019). Therefore, quantitative assessment on managing sustainable competitive advantages through technology and innovation can enhance the understanding of organisations such as city governments further, which is beneficial to enriching and improving the existing management models of organisations like city governments or metropolitan cities.

## An understanding of technologies

Every business organisation has several technical functions. Literature demonstrates that companies can use the technology in different ways to retain a competitive advantage including the introduction of new goods and services, improvement in product efficiency, the design and manufacture of tailor-made products for the intended customers (see Table 1). Throughout the distribution of goods and services and even in the manufacturing cycle, technology is being used for day-to-day purposes. A technology-based production company, for instance, is responsible for conversion of raw materials, which contains products, systems and services and the use of available competences and equipment for finished and semi-finished goods and services (Bleicher 1991).

## An understanding of innovation

The global business climate is constantly evolving to such an extent that critical changes are needed to prevent adverse effects on the strategies of the company. Companies must adapt to the requirements of their internal and external environments to maintain their marketplace in the sector. Innovation must be based on a new (or significantly

enhanced) product, process, technological promotion or organisational strategy. It includes products, processes and strategies initially created by corporations and collected from other institutions or businesses, such as the literature, including product innovation, method innovation, marketing innovation, organisation's innovation and concept innovation (Gibbons et al. 1994; Yu et al. 2017). All these forms of innovation either refer to the creation of something completely new or the improvement in the products of processes. In a nutshell, innovation is defined by Morck and Yeung (2001), as the implementation of new ideas in the business processes or the first attempts to carry out an idea into practice.

Technological innovation is a diversified aspect, which addresses the acquisition of new products or processes or the use of technology in broad terms, change management. Throughout the process, companies, using a competitor benchmark in the industry, gain competitive advantages by systematically choosing, introducing and leveraging available technology. Considering these contemporary explanations on technological innovations and their implications on competitiveness, early scholarly articles also raise similar arguments. In fact, current scholarly articles on technological innovation build on early works on this subject (Zhang et al. 2018). Seminal works by Subrahmanya (2005), talk about innovation as involving new products and services, new methods of producing and distributing goods, new sources of customers and suppliers, exploration of new markets and new organisation of businesses. There is a need for intensive R&D to ensure that there is continuous innovation in the organisation. On this note, the individuals are the key players in the R&D because without people and the related human capital, there will be no research or any technological and innovation aspects. Thus, this research study seeks to address the issues of managing competitive advantage through technology and innovation by developing a conceptual framework. On the other hand, the study helps to provide an understanding of how technological innovation factors affect the performance of organisation effectiveness.

## Managing competitive advantage: An overview

The problem of competitive advantage and its effect on an organisation's operations are critical at this juncture. According to Dirisu, Iyiola and Ibidunni (2013), an organisation is believed to have competitive advantage when the existing or prospective competitors cannot match its activities. This can either be because of the lack of capacity of the competitor or the high costs involved in the imitation. In other words, scholars such as Zain et al. (2014), speak of competitive advantage as a situation where the organisation has absolute control over its competition in an area or any line of work such that they have larger market share and operate as market leaders. In terms of product uniqueness as a determinant of a business's competitive advantage, the goods provided must have a combination of art and the dimensions desired by the available customers. On the other

**TABLE 1:** Impacts of technologies on business management.

Business activities	Impacts on business
Reduced Costs of Operation	For example, Dell Computer Corporation used technology to lower manufacturing and administrative costs, enabling the company to sell computers cheaper than most other vendors.
New Product and Market Creation	For example, Sony Corporation pioneered the technology of miniaturisation to create a whole new class of portable consumer electronics (such as radios, cassette tape recorders and CD players).
Adaptation to Change	In the early part of the 21st century, companies addressed how small devices such as cell phones, personal digital assistants (PDAs) and MP3 players could practically become and how each product could support various features and functions. For example, cell phones began to support e-mail, web browsing, text messaging and even picture taking as well as phone calls.
Improved Customer Service	The sophisticated package-tracking system developed by Federal Express enables that company to locate a shipment whilst in transit and report its status to the customer. With the development of the World Wide Web, customers can find the location of their shipments without even talking to a Federal Express employee.
Reorganised Administrative Operations	For example, the banking industry has reduced the cost of serving its customers by using technologies such as automated teller machines, toll-free call centres and the Web. As of early 2005, the cost of a bank transaction conducted by a human teller was approximately \$2, compared to \$1 for a telephone banking transaction, \$.50–1.00 for an ATM transaction and about 10 cents for banking over the Internet.

hand, product quality suggests the quality of design from company quality, whereas competitive price refers to the ability of an organisation to adjust its product prices to general market prices (Dirisu et al. 2013).

In addition to the dimensions discussed above, quality products are also determined to be essential for a business's competitive advantage (Srivastava, Franklin & Martinette 2013). Product quality is founded in the concept of quality management, whereby an organisation aims to satisfy client anticipations and meet the international quality conditions (Case 2002). Similarly, the issue of information management should also be taken into consideration as one of the aspects that is essential for the competitiveness of an organisation (Sambamurthy, Bharadwaj & Grover 2003).

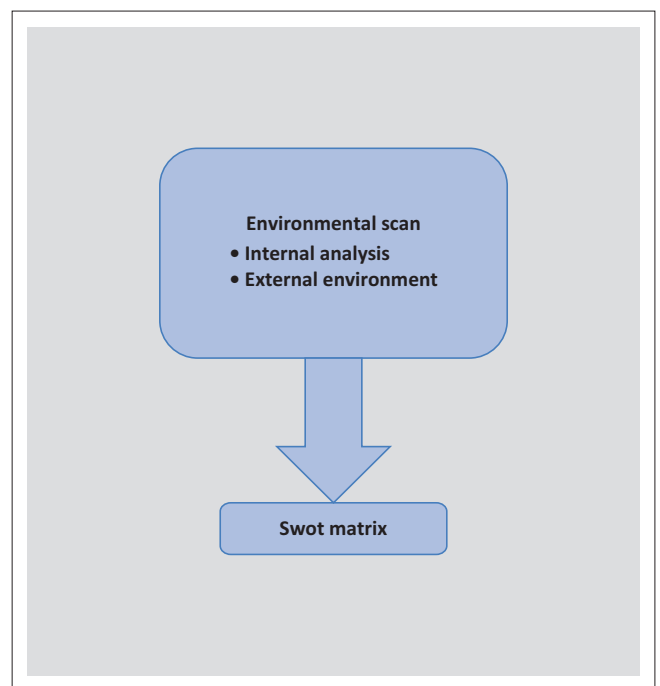
### Strengths, Weaknesses, Opportunities and Threats analysis and competitiveness

The aspect of Strengths, Weaknesses, Opportunities and Threats (SWOT) is a business device that helps business organisations to analyse their strengths in business, weaknesses they face, opportunities available to them and weaknesses involved in operations (Nouri, Karbassi & Mirkia 2008). When the SWOT analysis is completed, a company's management will have the chance to achieve its goals by using the available resources and finding the obstacles to its capacity and how to reduce or resolve them.

Strengths, Weaknesses, Opportunities and Threats analysis starts with an environmental scan where the management of an organisation conducts an internal and external environment scan to determine the first stages of the strategic management planning process (see Figure 1). In terms of the internal environmental scan, the organisation conducts an analysis of its internal strengths and weaknesses. According to Riston (2008), the strengths of an organisation refer to the resources available to the organisation and the capabilities at their disposal, which help an organisation to have a competitive advantage against its competitors (Schilling 2008). Some of the common resources that extend the strengths of an organisation include but not limited to the following:

- The patents, trademarks or copyrights available in the organisation.
- The existence of strong brand names in the business.
- High levels of referrals, good reputation and positive word-of-mouth from the customers.
- Costs advantages available to the organisation.
- Organisation's access to high-quality goods and services that increase customer value.
- The firms' favourable access to distribution networks.

On the other hand, internal environmental analysis also enables an organisation to determine its internal weaknesses (Riston 2008). In other words, the lack of certain strengths in the organisation is regarded as a weakness in the business operations. Literature also notes that the weaknesses of business entity can also be a flip side of its



SWOT, Strengths, Weaknesses, Opportunities and Threats.

**FIGURE 1:** Linkage between environmental analysis and Strengths, Weaknesses, Opportunities and Threats matrix.

strengths. For instance, large business organisations can have a competitive advantage of their capacity for mass production and benefit from economies of scale, but these can be their weakness if they do not quickly react to the changes in the strategic environment. This implies that instead of benefiting from their capacity, large enterprises will face disadvantages as a result of failure to take advantage of their competitive advantage. According to Nouri et al. (2008), the following are some of the weaknesses identified in the organisation:

- Lack of trademarks, inventions and patent protection.
- The existence of poor brand names in the organisation.
- Poor reputation amongst customers and high levels of negative word-of-mouth.
- High operating costs.
- Lack of access to high-quality products, which increases customer value.
- Poor access to effective and efficient key distribution channels.

To create strategies that consider the SWOT profile, a matrix of these factors can be constructed as presented in the SWOT analysis matrix (see Table 2).

The SWOT analysis matrix (see Table 2) shows the relationship between external and internal environmental analyses. As presented in the above table, the S-O strategies present the relationship between the strengths and opportunities of the organisation and how these can be a good fit in the organisation. Considering this, the organisation makes use of its strengths to efficiently utilise the opportunities available to them (Whalley 2010). On the other hand, the W-O strategies represent the relationship between the weaknesses of the

**TABLE 2:** Strengths, Weaknesses, Opportunities and Threats analysis matrix.

TOWS	Strengths	Weaknesses
<b>Opportunities</b>	<b>S-O Strategies</b> How can an organisation make use of its strengths to take advantage of the opportunities available to the organisation?	<b>W-O Strategies</b> How can an organisation minimise, prevent or overcome the weaknesses that can prevent it from taking advantage of the opportunities available to the entity?
<b>Threats</b>	<b>S-T Strategies</b> How does the organisation make use of its strengths in order to reduce the impact of threats available?	<b>W-T Strategies</b> How can an organisation address the prevailing weaknesses that will make the threats a reality?

Source: Adapted from Whalley, A., 2010, *Strategic marketing*, Andrew Whally and Ventus Publishing APS, London, ISBN 978-87-7681-643-8

TOWS, Threats, Opportunities, Weaknesses and Strengths.

organisation and the available opportunities. On this note, the W-O strategies enable the organisation to try to eliminate all the weaknesses it has that will bar it from utilising the opportunities available to the entity. Contrary to that, the S&T strategies, which show the relationship between the strengths of the business organisation and the external threats, provides management with an opportunity to make use of its internal strengths. This opportunity includes organisational commitment and specialty to reduce the impact of threats available, for example, the threats of competitors (Clardy 2007). The W-T strategies address the weaknesses in the organisation and how they make the available threats a reality. In conclusion, SWOT analysis is an essential step in the strategic planning of an organisation and has an implication in the competitiveness of a business organisation. In a nutshell, the SWOT investigation and the SWOT analysis framework give information that is suitable in directing the organisation's assets and capabilities to the competitive condition in which it works. In that capacity, it is instrumental in technique detailing and determination.

## Methodology

The methodology used in this study is mainly the secondary data analysis. This section rationalises the selection of the preferred methodology, deals with data collection and data analysis and covers how data originated from secondary data sources. With regard to the literature reviews for this study, the selection of diverse scholarly works for this study takes a thematic approach. The review covered a variety of scholarly works that are deliberated together with the data compilation and elements of analysis, whereas for the secondary data selection and collection methodology, the established criteria for inclusion and exclusion procedures are also extensively reviewed, together with the selection stratagem. The boundaries of the research approaches are broadly deliberated, followed by the ethical contemplations adopted for this research study.

This study collected data through the secondary data analysis process, which allows the researchers to locate and utilise the summarised data or information collected by others and consequently shape a hypothesis, rather than the traditional technique for first framing a theory, at that point trying to demonstrate it through surveys and then looking for substantiating it through questionnaires (Camic, Rhodes & Yardley 2003). A complete and thoroughly secondary data

analysis process has been utilised as a research method and approach to complete this research work. This study also collected secondary data from various aspects such as workshops, document analysis/review or desktop study, official statistics, technical reports, scholarly journals, literature review articles, trade journals, reference books, government documents, research institutions, universities, libraries, and inter alias. This was made in order to obtain relevant secondary data from management information systems (McCaston 1998) on a convenient basis from the Science and Technology Policy Research and Information Center (STPI) under the Ministry of Science and Technology, which concerns about the Kaohsiung City Government, Taiwan. Finally, the study concludes with the discussion of ethical issues, strengths and limitations or challenges related to secondary data analysis as a research methodology, particularly for this study.

## Research design

The research design used in the present study was a comprehensive secondary data analysis. The target population for the study had covered secondary data from Kaohsiung City Government only.

Therefore, the target population was, therefore, specifically on the secondary data sources such as workshops, document analysis/review or desktop study, official statistics, technical reports, scholarly journals, literature review articles, trade journals, reference books, government documents, research institutions, universities, libraries and inter alias. These data were derived from the Taiwanese Nationwide Document Delivery Service (NDDS), through the STPI under the Ministry of Science and Technology that concerns about the Kaohsiung City Government, Taiwan. This was performed in order to obtain relevant secondary data from management information systems (McCaston 1998).

This study approach was selected as it is linked with secondary analysis, which is more cost-effective and suitability. This is also because the secondary dataset is usually easily accessible and the researcher can base his/her project on a large scope of data (McCaston 1998).

## Research method used in this study

The subjective research technique is utilised to assist in answering enquiries concerning the nature of phenomena with the motivation behind depicting and understanding them from the secondary data analysis point of views. The qualitative research methodology eased the analyst to assess things in their natural surroundings, endeavouring to understand, or interpret occurrences concerning the consequences that individuals carry with them.

## Secondary data analysis process

Johnston (2012) submitted that technological developments have prompted immense measures of information that has

been gathered, ordered and chronicled, which is currently effectively available for research. The present study affirms that secondary data analysis is a feasible data analysis technique to be used during the time spent on request when a deliberate method is taken after and gives an explanatory research presentation using secondary data analysis in managing technology and innovation study.

The use of these existing data offers a realistic option to researchers who might have constrained time and resources. This research work emphasises on the attests that secondary data analysis is a reasonable technique to employ throughout the time spent when a methodical technique is taken later. This study contemplates to add to the discourse of secondary data analysis as an exploration strategy for managing technology and innovation for sustainable competitive advantage to illustrate and indicate the technique, advantages and constraints in leading an examination using an optional data inquiry technique.

### Defining secondary data analysis

The idea of secondary data investigation and analysis initially rose with Glaser's talk of re-breaking down information, 'which were initially gathered for different determinations' (Glaser 1963:11); however, there remains a shortage of writing that particularly tends to the procedure and difficulties of directing secondary data enquiry and investigation (Andrews et al. 2012; Smith 2008). Hakim (1982) characterised secondary analysis as:

[A]ny further investigation of a current dataset which grants translations, ends or information extra to, or not quite the same as, those demonstrated in the primary offer specifics concerning the demand and its fundamental outcomes. (p. 1)

Most research studies begin with a consideration of understanding what is currently well-known and what remains to be discovered out concerning a point by looking into secondary sources and analyses that others have early led in the scheduled region of conspiracy. Secondary data analysis makes this one advance further, involving a scrutiny of beforehand collected data in the area of interest. Although secondary data analysis is an easy-going methodology and could be utilised in rare diverse methods, it is equally an empirical practice with bureaucratic and evaluative developments, likewise as there are in assembling and measuring fundamental data (Crossman 2019; Doolan & Froelicher 2009). Secondary data analysis is still not fully utilised as a research method in numerous fields, involving the Library Information System (LIS).

Given the undeniable availability of already collected data to researchers, it is imperative to furthermore distinguish secondary data analysis as an orderly research technique. Conversely, various systems are available to direct researchers as they lead secondary data analysis (Andrews et al. 2012; Smith et al. 2011).

### Process of secondary analysis

Secondary analysis is a methodical technique with technical and evaluative phases and still, there is a non-existence of writing to portray a certain technique; thus, this article suggests a technique that commences with the improvement of the research questions, at that point the identification of the dataset and by means of assessing the dataset. This system is represented by the present research in which the investigator examined the ways to deal with managing technology and innovation for competitive advantage.

### Strengths and limitations of secondary analysis for this research study

The key benefits related to secondary analysis are the cost viability and suitability it offers. Because another individual has effectively collected the data, the investigator does not require to dedicate monetary assets for the collection of data. At the stage, when great secondary data are reachable, investigators can obtain and utilise high-quality larger datasets, for instance, those collected by sponsored studies or organisations that composed of bigger samples and hold substantial coverage. The bigger samples are more demonstrative of the target population and consider more noteworthy legitimacy and more generalisable conclusions. Having admittance to this kind of data provides access to all investigators, even the beginner or unfunded researcher, consequently levelling chances and building limit with respect to empirical study (Johnston 2012) in the LIS enquire about.

### Ethical considerations

This article followed all ethical standards for a research without direct contact with human or animal subjects.

### Results and discussion

This section presents the findings and key outcomes obtained from the study with regard to the issues of managing competitive advantage through technology and innovation in the context of metropolitan cities, particularly from the Kaohsiung City Government, Taiwan.

### Research and development in supporting technology and innovation at the Kaohsiung City Government

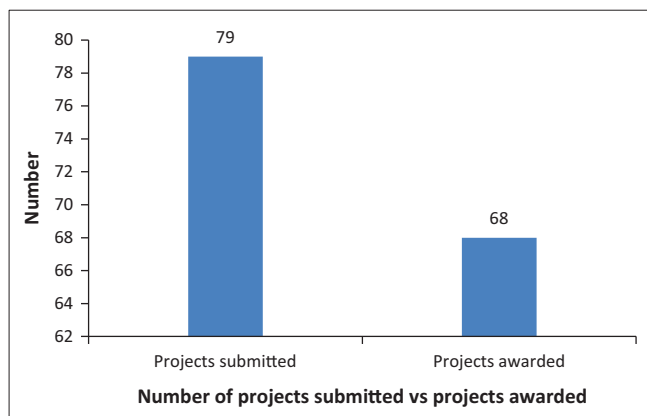
Under this section, we discuss the findings from the present investigation, particularly in terms of R&D and more specifically, how R&D is used at Kaohsiung City Government to enhance technology and innovation.

### Promoting research and development

Municipal administration innovation proposals: The study has revealed that, in order to inspire and empower employees of different Departments and schools under the government to propose innovation with respect to the current city's development or reform and to enhance

municipal services or quality and organisational effectiveness, the 2016 Municipal Administration Innovation Proposal Review and Awards were composed by the Kaohsiung Municipal Administration Innovation Proposal Review and Award Rules. Different Departments submitted 79 proposals, whereby specialists and researchers were procured to lead the reviewing process (Kaohsiung City Government [KCG] 2016). By and large, 68 proposals were approved on recommendations of various experts and were distributed on the City Government Research Result website (<http://research.kcg.gov.tw/chinese/index.aspx>) as shown in Figure 2, whereas the proposals that acquired second-level prizes or better were additionally submitted to appropriate Departments for reference and use (KCG 2016).

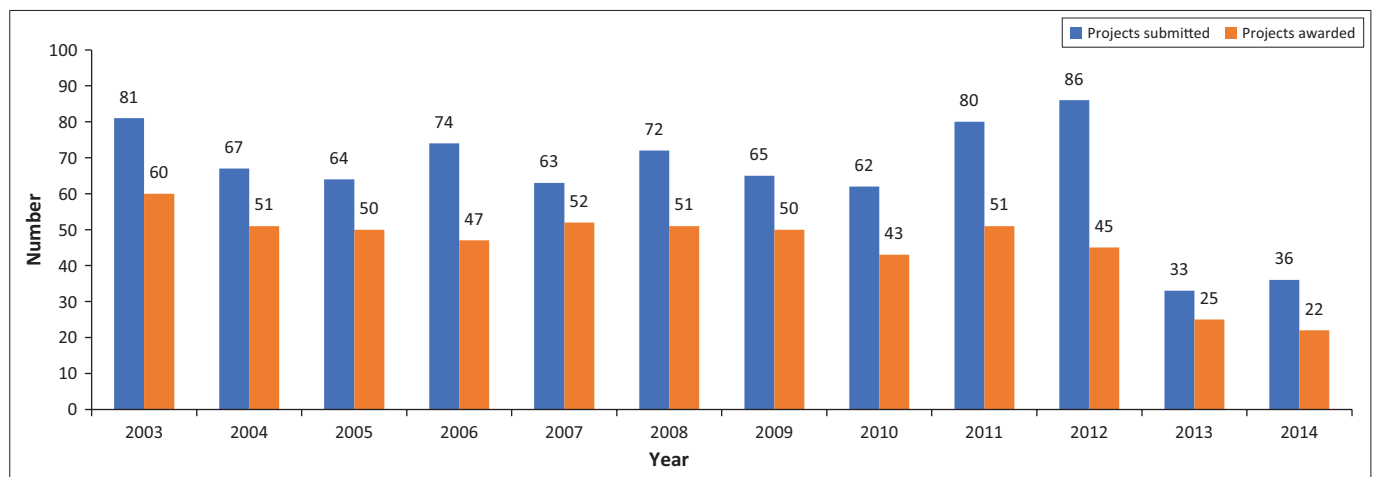
This study has discovered that the Kaohsiung City Government through its seven different Departments or agencies had outsourced seven diverse research projects in the year 2016 (see Table 3). These research projects were commissioned to five national universities and one private company. Seven different Departments of the Kaohsiung City Government were mandated to be commissioning



Source: Kaohsiung City Government (KCG), 2016, *Overview of Kaohsiung City Administration (2016)*, Research, Development and Evaluation Commission (RDEC), Kaohsiung City Government, viewed 29 July 2018, from <http://rdec.kcg.gov.tw/>

**FIGURE 2:** Kaohsiung municipal administration innovation proposal results (2016).

[AQ1]



Source: Kaohsiung City Government (KCG), 2014, *Overview of Kaohsiung City Administration (2014)*, Research, Development and Evaluation Commission (RDEC), Kaohsiung City Government, viewed 27 July 2018, from <http://rdec.kcg.gov.tw/>

**FIGURE 3:** Kaohsiung City Government Research and Development Results Statistics (2004–2014).

agencies for the outsourced research projects. The Kaohsiung City Government has been commissioning research projects through various institutions or companies and Figure 3 shows the R&D results statistics from 2003 to 2014. The highest number of projected proposals that were approved and awarded was in 2003, whereby 60 out of 81 projects were awarded or approved (KCG 2014). The lowest number of projects awarded was recorded in 2014 with only 22 projects approved (see Figure 3). These results are a good indicator in determining how R&D supports technology and innovation. Thus, it becomes relevant in developing a conceptual framework for assessing the effects of managing competitive advantage through technology and innovation in the context of metropolitan cities. These results also help to provide an understanding of how technological innovation factors (arising from R&D) affect the performance of organisation effectiveness.

Annual research, subsidies and rewards: To additionally advance innovative work through R&D, the city government had drawn up the Kaohsiung City Government Outlines for Evaluating, Reviewing and Rewarding Research and Development Projects. This study discovered that in 2014, research financing that added up to NT\$96 000 was given to 25 departments and school ventures and a sum of 36 research outcomes were submitted (KCG 2016). Researchers and specialists were chosen to direct initial and secondary evaluations and 22 projects were chosen. Reports of the compensated research results were sent by letter to different departments for reference and furthermore distributed in the city government's result network for research that deals with the metropolitan administration (KCG 2015; KCG 2016). These results are important for the current study in sense that they give a clear picture of how city governments, metropolitan cities or municipalities can provide research subsidies and rewards as an effort to promote R&D. R&D is the backbone of technology and innovation and thus, these results are imperative to the objective of the present study.

**TABLE 3:** Kaohsiung City Government agencies outsourced research cases in 2016.

Item	Commissioning agency	Research topic	Commissioned Agency
1	Research, Development, and Evaluation Commission	1999 Big Data Analysis and Utilisation Research	Eland Information Co., Ltd.
2	Social Affairs Bureau	Early Identification Model and Medical Care Team Operating Procedure for Sexual Assault Cases in Kaohsiung City	National Pingtung University of Science and Technology
3	Labor Bureau Bo-Ai Vocational Training Centre	2016 Study and Analysis of the Effectiveness of Job Redesign Service for Mentally and Physically Disadvantaged People in Kaohsiung City	National Pingtung University of Science and Technology
4	Kaohsiung Museum of Fine Arts	View of the Kaohsiung Awards: How Young Artists View the Kaohsiung Awards	National Kaohsiung Normal University
5	Social Affairs Bureau	Kaohsiung City Children and Adolescents' Life Situation and Needs Survey	Kaohsiung Medical University
6	Research, Development, and Evaluation Commission	Introduction of Kaohsiung City Elderly Long-Term Care Service into Social Enterprise Operation Method for Use	National Sun Yat-sen University
7	Kaohsiung Museum of Fine Arts	Southern Taiwan Fine Arts Association – Southern Exhibit (commissioned research project)	National Pingtung University

Source: Kaohsiung City Government (KCG), 2016, *Overview of Kaohsiung City Administration (2016)*, Research, Development and Evaluation Commission (RDEC), Kaohsiung City Government, viewed 29 July 2018, from <http://rdec.kcg.gov.tw/>

## Technological factors and information development at the Kaohsiung City Government

Technological and innovative components are factors that are being utilised for assessing accessible choices concerning technological competences. Many organisations think of them as a vital instrument for enhancing activities and functions. Technological variables are one of the different external environment factors that influence organisations significantly and are likewise an indispensable part of the PESTLE investigation. In the present situation, most extreme reliance on hardware, innovative elements can have more impact on business activity and achievement all around than at any other time (KCG 2017).

### How technological factors affect business environment

Technology and innovation patterns influence organisations and business entities at multiple levels. At the stage when employees are efficient, they end up being productive. Furthermore, when a business is more into interaction with its existing and prospective customers, it has more opportunities to establish a solid customer trustworthiness base (Choy & Park 2016). Evolution of innovation and technology can make this imaginable. Key innovators are always enquiring for development and apprise within the innovative and technological environment. Thus, they are not only enhancing their tasks, but also will similarly be very much cognisant of the business transformational period. They will extrapolate ground-breaking stratagems to advance their businesses exponentially (Abdulwahed 2017).

### Technology transforms operations

The technological environment of business has tremendously transformed the manner in which organisations operate. This is

the case with the Kaohsiung City Government as the progressions in technology and innovation around data innovation within the City Government have comparatively presumed control over each division of the institution. Currently, data are kept in information servers and cloud innovation as against the old method for putting away information in registers and records. Moreover, advancement of innovation and technology has similarly presented computerised showcasing stratagems through which organisations can offer their items and services. Indeed, even the innovative work by R&D divisions in organisations have changed their method of working and further developed systems for the improvement of items and services that have been presented just through technological development. For instance, Siemens and Boeing were massively putting resources into the adaption of 3D printing strategy for item planning. They trust that this will quicken the planning procedure, diminishes creation cost and enhances the viability of outlining (Abdulwahed 2017).

### Technology helps in developing marketing strategies

Nowadays, technology has acquired a significant revolution through which organisations gather, record, recover and use information, which can equally help them in creating pivotal business approaches and techniques (Yuan 2017). It is through accessible information that the Kaohsiung City Government can screen and assess client patterns and their requests for a specific item or product and services. On account of the progression of data innovation and technology, organisations can comprehend customers' behavioural conducts, lead a full-scale analysis and create the promoting methodologies as needs be. Technology is not helpful for gathering and utilising information; however, in this regard, it is likewise being utilised by institutions to examine information and make significant conclusions and additionally well-versed choices. Having more attention on the clients, business methodologies will positively end up being powerful for the achievement of a business entity and this is true with the Kaohsiung City Government.

### Promotion of smart city development in Kaohsiung City Government

Cities in Taiwan are densely populated areas with greatly developed industry and commerce, particularly Kaohsiung City as an economic hub for Taiwan. They normally comprised well-designed functional zones, for example, residential, industrial and commercial zones, and have administrative jurisdiction (Wu et al. 2018). Smart cities use information technology in these zones to offer a range of convenient smart applications and deliver various services in order to enable them to promote a much more harmonised public and natural development.

### Matching government, industry, academic and research institutions and drive cross county and city cooperation

In order to manage the City Government's different smart city developmental assets, encourage collaborations amongst industry, government, scholarly and research establishments and utilise cross district/city administration technique to enable different departments to obtain the Smart 4G



Broadband City Project from the Industrial Development Bureau, Ministry of Economic Affairs (MOEA), (KCG 2016). To this effect, four tender proposals have been passed by the City Government in order to fulfil its mandate.

### Actively seeking central government subsidies

The City government has given NT\$ 17 million in appropriations from the Architecture and Building Research Institute, Ministry of the Interior and moreover, NT\$ 4 m from the National Development Council's 'Smart Homeland' to sort out the Kaohsiung Ecomobility Smart Community group, the Kaohsiung City Information Platform, the Kaohsiung City Smart Creative Settlement Virtual Reality Experience Space and the Air Quality Micro Sensory Net and Rotation System for the 2017 Ecomobility World Celebration (KCG 2016; KCG 2018). This fruitful experience from the exhibition site can be utilised as a building basis for advancing smart city by the City Government as displayed in Table 4.

### Effect of government, policies and regulations on technology strategy

Government strategy and different guidelines, ideologies and directions affect the company's technology and innovation system and its endeavours towards advancement of both as far as financing and arrangement of rules for improvement are concerned. At a large-scale level, a portion of the basic components are strategies embraced to advance macroeconomic dependability, policies warranting resources allotment as per the most preferred angle, quick gathering of physical and human capital, improvement of horticultural sector and advancing skilful administrations (Dasgupta 2009).

However, in Taiwan, there is a need to balance technology and innovation policies that help conventional industry with provisions that better react to issues of rivalry and enterprise development (Sağ, Sezen & Güzel 2016). Whilst the progression measures attempted by the Central Government hit hard the small and medium enterprises (SMEs), which thought that it was difficult to survive the aggressive competitive, the expenditure plan of the central government presented an exceptional arrangement for enhancing credit streams to the SMEs. This is quite like what happened in China, whereby the government is dedicated to drive various administrative

**TABLE 4:** Projects for promoting smart city development at Kaohsiung City Government.

Items	Directing county/city	Proposed theme	Cooperating counties and cities
1	Kaohsiung City (Tourism Bureau)	Smart travel	Chiayi City, Chiayi County and Tainan City
2	Kaohsiung City (Education Bureau)	Smart health and safety	Pingtung County and Chiayi County
3	Pingtung County (Department of Agriculture)	Smart agricultural information platform	Kaohsiung City
4	Taipei City (Department of Information Technology)	Local specialties 020	Kaohsiung City, Taichung City and Keelung City

Source: Kaohsiung City Government (KCG), 2015, *Overview of Kaohsiung City Administration (2015)*, Research, Development and Evaluation Commission (RDEC), Kaohsiung City Government, viewed 24 July 2018, from <http://rdec.kcg.gov.tw/>

changes and institutional reforms that are essential to improve the Chinese learning creation and innovative capacities. This is demonstrated in the expansion in R&D funding. Most importantly, the 'open policy strategy' rehearsed by the government remains the genuine key to the adjustment in development elements and advancement (Huang et al. 2010).

The regulatory boundaries to entry furthermore play a critical role in determining the dominance of companies in certain areas. Thus, strengthening of patent laws equally assumes a critical part in changing institutions from imitators to pioneers (Kale & Little 2007). The expanding significance of ecological issues prompts technological innovation transformation and organisational change to endorse it (Cozzarin, Kim & Koo 2017).

### Development of conceptual framework to identify areas for further research

Based on the result of reviewing and evaluating the relevant literature and theories taken together, a model was developed and proposed. This model describes the relationship between technology and innovation management strategy, technological innovation and organisational factors. Technological innovation in an organisation is determined by its technology and innovation management strategy, which has its origins in the business strategy of the organisation or firm. The feedback attained from the application of technological innovation and the progression of technology should form the foundation for the organisation to evaluate its technology and innovation management strategy. The function of the government along with several directives, the technology foresight, the technology and innovation scouting all have positive effects on the organisation's technology and innovation management strategy. However, the organisational factors, technology foresight, as well as technology and innovation scouting all play a significant role in establishing a learning environment to encourage the management of technology innovation for sustainable competitive advantage. The bi-directional arrow between technology and innovation management strategy and organisational factors visualises that it is not only the organisation's technology and innovation management strategy, which has an effect on diverse organisational factors. However, different factors such as the expertise level and accumulated experience of employees play a significant role in relation to the organisation's option of technology and innovation management strategy for implementation. The outcome on evaluation of effects on managing technology and innovation for sustainable competitive advantage can be measured as organisational performance with respect to its operations and business effects on service delivery. The model depicted in Figure 4 has to be empirically tested out for its feasibility.

### Implications to the management of technology and innovation

Managing sustainable competitive advantage through technology and innovation is a complex issue and needs

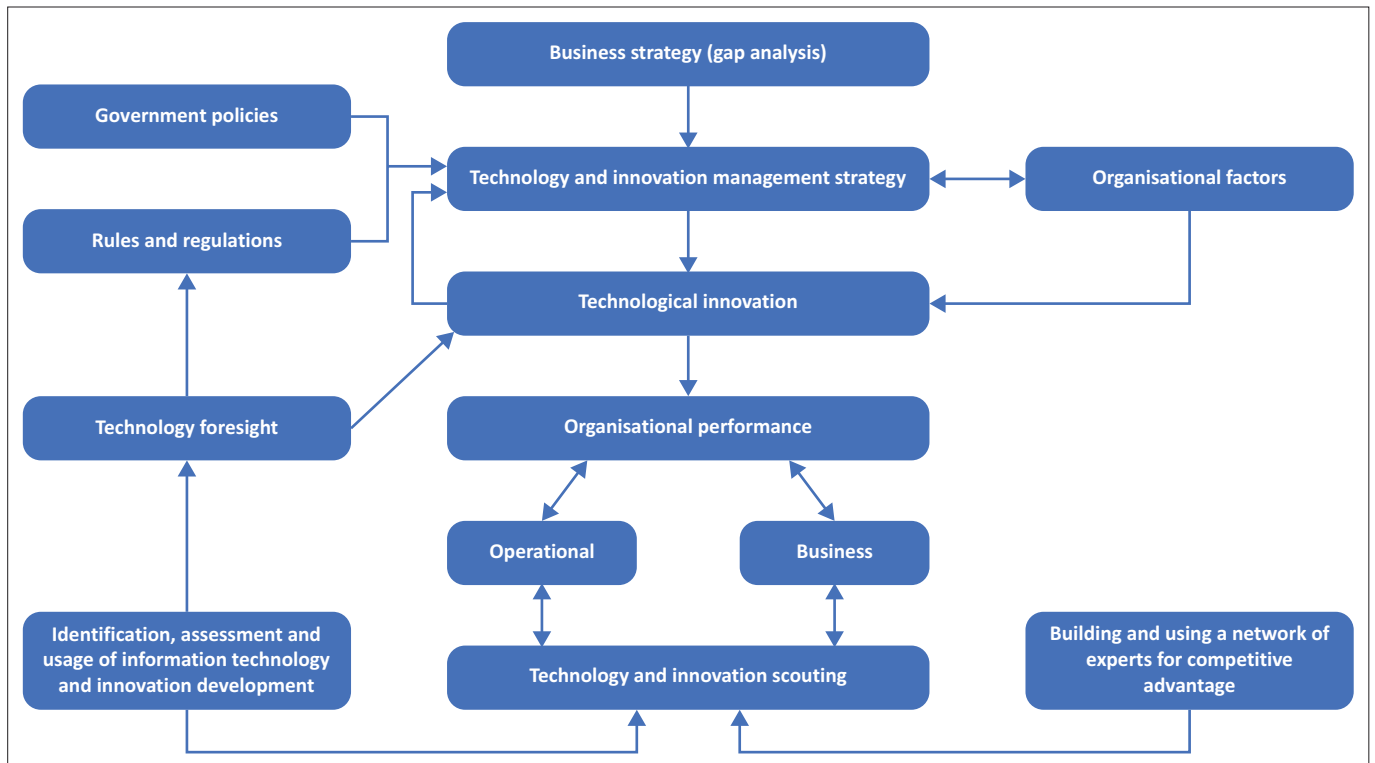


FIGURE 4: Technology and innovation management strategy model.

further consideration as far as theoretical development and approaches to the management of technology and innovation are concerned. This investigation was provoked and driven by the absence of consideration given in the available literature and the framework (theory) to the impact and strategies of managing sustainable competitive advantage through technology and innovation in the metropolitans or municipals and local authority governments context, especially in the public sectors of the local authorities' governments (Hunting, Ryan & Robinson 2015). This research study distinguished various key persuading factors such as competitive advantage, public concerns and expectations, organisation's competence, costs included in managing technology and innovation, rapidly advancing technologies, ageing technology and under-investment and top management commitment, which can be established into new theories and hypotheses for additional testing and improvement (Desouza et al. 2015). This decrease of information by distinguishing key components is critical for framing future research.

At the same time, the conceptual framework developed in this study, reflecting the bond between managing competitive advantage techniques through technology and innovation and business performances can be applied to different business sectors of the central government, to different businesses or to different countries confronted by similar challenges and issues of managing technology and innovation (Desouza et al. 2015).

## Conclusion

In city governments in Taiwan and across the globe, managing sustainable competitive advantage through

technology and innovation appears to have similar challenges and local government organisations confront several common challenges including:

- Political shifts as a result of changes in local governments' administrations and leadership.
- Restricted resources and consistent demands putting pressure on local or city governments' services.
- Mounting pressure to keep on delivering appropriate and astounding administrations and high-quality services with no space for open experimentation or disappointment.

Despite these difficulties, there are few cases of managing sustainable competitive advantage through technology and innovation practices in city governments, where technology and innovation are best comprehended and best bolstered. This is because of the presence of various variables, including:

- Gaining support from senior management plus management backing within political organisations.
- Understanding of the value of technology and innovation and a capacity to tell this story and engage people in this narrative.
- Sharing skills and information to empower others to make positive change and going past affecting people's abilities to make culture change.

There are crucial technological innovation factors that are involved in managing technology and innovation that were discovered through this research study, which will provide interesting learning for those looking to implement and manage them for positive changes within their own local government organisations.

Five key significant effects on managing sustainable competitive advantage through technology and innovation in the local government authorities are identified through this research:

1. Technology and innovation transform organisation's operations and promote business development.
2. Promotion of the Inter-Agency Public Services Informational Platform, enhancing service delivery and added monetary value for taxpayers.
3. Promotion of smart city development and industrial development and transformation.
4. Infrastructure and Information Security Management – Promotion of Information Security Management System (ISMS).
5. The ISMS of the City Government, as well as organising information security reporting drills.

Managing sustainable competitive advantage through technology and innovation is not a means to an end, yet a set of tools and strategies in ensuring proper service delivery to the people and communities. It is therefore essential to have a realistic vision and practical approaches to the management of sustainable competitive advantage through technology and innovation and goal-oriented objectives for city governments and the City Government must take necessary steps to develop strategies for managing technology and innovation that will set the City Government on the way to work better on service delivery and distinctively utilising new technology and innovation.

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## Competing interests

The authors have declared that no competing interests exist.

## Authors' contributions

K.T.T.A. conducted the overall research study whilst being registered as a student at the Tshwane University of Technology. E.I.E., V.N. and S.P. supervised the findings of this work. All the authors discussed the results and contributed to the final manuscript.

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## Data availability

The data that support the findings of this study are available from the corresponding author (K.T.T.A.), upon reasonable request. The linkage between Environmental Analysis and SWOT Matrix (Figure 1) and Technology and innovation management strategy model (Figure 4), developed by the researcher (K.T.T.A), is the intellectual property of the said researcher.

## Disclaimer

The views and opinions expressed in this article are those of the authors and do not necessarily reflect the official policy or position of any affiliated agency of the authors.

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