# Strategic Digital Leadership in the Public Sector for Digital Transformation Towards Enabling Sustainable Digital Economy in Thailand

Kriengkrai Bhuvanij
School of Information Technology,
Sripatum University, Bangkok, Thailand,

Thana Sukvaree
School of Information Technology,
Sripatum University, Bangkok, Thailand,

Prasong Praneetpolgrang
Academic Faculty, Navaminda Kasatriyadhiraj Royal
Air Force Academy, Thailand,

Navarat Saekhow
School of Information Technology,
Sripatum University, Bangkok, Thailand,

*Abstract*— **This research aims to find competencies required for strategic digital leadership (SDL) in public sector for digital transformation (DT) towards enabling sustainable digital economy (SDE) development in Thailand and relationship among these three key components.  The research was conducted in both qualitative and quantitative methods by using structural equation modeling (SEM) methodology and analysis with 312 samples from representatives in the organizations in public sector.  From the study, it founds out that, in public sector, 1. SDL impacts on DT (Loading Factor (FL) = 0.59), 2. DT impacts on SDE (FL = 0.79), 3. SDL has least impact on SDE (FL = 0.07), 4. Strategic competency plays major roles in SDL (FL = 0.95), 5. Ethics which is the newly proposed pillar in this research besides the current existing ones which are economy, society and environment also has impact to SDE (FL = 0.76) and 6. Operation process is the mostly important factor on DT (FL = 0.94). The innovative outcomes of this research could be very useful to government and public sector policy makers on building up the right key competencies related to the needs of public organizations for SDL to digitally transform the organizations which could bring the organizations' sustainable digital economy at the end.  Most importantly, the leader could not alone and directly order the organizations to achieve the sustainable digital economy but the systematic digital transformation through the right strategic digital leadership competencies is certainly required.**

*Keywords— Digital transformation; strategic leadership; digital leadership; sustainable digital economy*

## I. INTRODUCTION

Across the world, governments aim for transformation of public administration in order to adapt to a changing environment and address societal challenges. Transformational objectives include realizing organizational change beyond improved service delivery to citizens, facilitated by the use of information technology (IT) or digital technology (DT) to create public value and increase governments' responsiveness and openness [1-2].  Hence, the transformation in the public sector can be seen within the wider context of public sector reform which the objectives of this reform include making savings (economies) in public expenditure, improving the quality of public services, making the operation of government more efficient, and increasing the chances that the policies which are chosen and implemented will be effective.

In the context of the public sector, digital transformation is considered as the application of IT/DT solutions to improve the accessibility and efficiency of public organizations. The analysis of the findings of empirical and conceptual studies reveals two potential benefits of digital transformation for the public sector [3]. Firstly, digital transformation improves organizational efficiency by bringing down running costs and increasing productivity. Secondly, the quality and variety of service provisions are found to improve as public organizations embrace digital transformation.  Public sector organizations are thus forced to carry out digital transformation which requires them to be more flexible and functional and challenges them to criticize existing processes to deliver better services to citizens.

However, the technology is only part of the complex phenomenon of digital transformation. Besides technology, researchers have identified other organizational aspects, such as the structure of the organization [4], culture, process and strategy of the organization [5]. This includes the notion that IT/DT is not only the means to support change, rather, processes, people, policies, and especially leadership need to be fundamentally changed to accomplish digital transformation in the public sector [6].

Therefore, digital transformation brings leadership and management challenges which the way businesses operate in the varieties of technologies today has led leadership to realize that they cannot continue using their traditional leadership competencies in the digital era [4], [7]. However, the little has been known about digital transformation and leadership.  Furthermore, a lack of research in the field of digital leadership skills and digital transformation has clearly been indicated by scholarly research [8] and industry research conducted [9]. There is a need for this type of study as not much research has been conducted in the combined field of leadership skills and digital transformation, as is indicated.  This also true for the public sector, hence, especially in this research, the study on the strategic digital leadership for digital transformation in the public sector in Thailand will be explored.  In addition, this research will expand the scope of study on the relationship among strategic digital leadership, digital transformation in public sector and sustainable digital economy

in Thailand. Hence, the research objectives will be as followings:

1. To find the key strategic digital leadership competencies for digital transformation in the public sector towards sustainable digital economy in Thailand.

2. To find the key outcomes from digital transformation in public Sector.

3. To find relationship of strategic digital leadership competency, digital transformation in the public sector and sustainable digital economy in Thailand.

## II. LITERATURE REVIEW

### A. Leadership

Leadership is defined as individual traits, leader behavior, interaction patterns, role relationships, follower perceptions, influence over followers, influence on task goals, and influence on organizational culture. [10]. Leadership is therefore considered to be about influencing people or a group of people to achieve a common goal [11].

### B. Digital Leadership

Digital leadership can be defined by its contributions and how it functions in a knowledge society. El Sawy et al. define digital leadership as when leaders do what is right strategically to ensure the success of digitalization for the organization and its business environment [12].

According to Goethals et al., digital leaders stand out from other leaders as they require a combination of new skills, attitudes, knowledge, and different experiences. Digital leaders need a vision for what they want to achieve, must be in search locally and globally for solutions, must have a passion for what they do, and must possess a hunger for constant learning from both their competitors and their peers [13].

### C. Competency

In the research of Spencer and Spencer, iceberg competency model in Figure 1 explains a better understanding of various competency categories [14]. The authors emphasized that it is often difficult for an organization to know whether an individual possesses these five competencies, i.e. skills, knowledge, self-concept, traits and motives and that some characteristics are difficult to acquire by training. Hence, they used the analogy of the iceberg. The characteristics at the bottom of the iceberg are more hidden and more difficult to develop. According to the iceberg model, knowledge and skills tend to be visible and relatively surface characteristics of individuals, whereas traits and motives are deeper and more central to personality. Self-concept characteristics fall somewhere in between. Hidden and visible competencies play different roles in the job. Hidden competencies are the behavioral competencies that drive an individual performance in a job, whereas visible competencies tend to be the technical competencies required by employers [14].



Fig. 1. Iceberg competency model [14].

With the competency model for the information technology (IT) workforce in Figure 2, Ho & Frampton [15] emphasize IT knowledge and skills to achieve work objectives. However, management and HR researchers also believe that traits and motivations are just as influential in competently and successfully performing in a position [16]. The study of Ho et al. [15] also defines expected competencies by professional IT architects (A Competency Model for the Information Technology Workforce) as the followings.
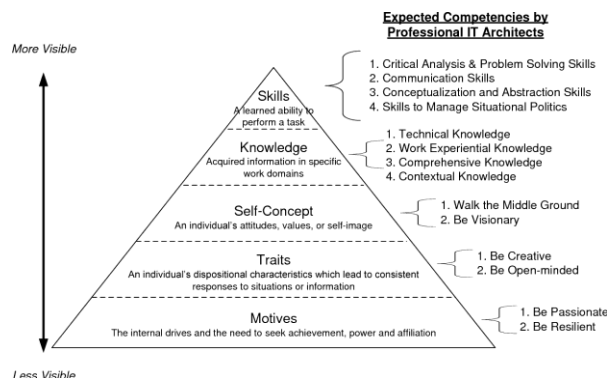


Fig. 2. Competency model for the information technology workforce (adapted from [14-15]).

More visible competencies:
- Skills (A learned ability to perform a task): Critical analysis & problem-solving skills, communication skills, conceptualization and abstraction skills, skills to manage situational politics.
- Knowledge (Acquired information in specific work domains): Technical knowledge, work experiential knowledge, comprehensive knowledge, contextual knowledge.
- Self-concept (An individual's attitudes, values, or self-image): Walk the middle ground, be visionary.

Less visible competencies:
- Traits (An individual's dispositional characteristics which lead to consistent responses to situations or information): Be creative, be open-minded.
- Motives (The internal drives and the need to seek achievement, power and affiliation): Be passionate, be resilient.

### D. Digital Leadership Competency in EU Model

The European Commission has the ambition to ensure that Europe can be a global leader for skills and talent for digital and key enabling technologies. Against this background the European Commission started the e-Leadership skills initiative in 2013. The Commission has recently commissioned a consortium of partners around empirica (www.empirica.com) to develop a proposal for an agenda on "Leadership Skills for the High-Tech Economy" and develop in the e-Leadership competencies triangle in Figure 3 consisting of strategic leadership, business leadership and digital technology leadership as detailed below [17].

The e-Leadership triangle:

- Strategic leadership: Lead inter-disciplinary staff and influence stakeholders across boundaries (functional, geographic). This competency consists of, but not limited to, forecasting needs for information including holistic view, understanding customer needs, solution orientation, communication, creativity, independent learner, team leading, cultures and internalization.
- Business savvy: Innovate business and operating models, delivering value to organizations. This competency consists of, but not limited to, customer relations and sales, partnership establishment, business development, organization change, project management, process optimization, strategic mastering, agile methodology, business analytics, market analysis and financial skills.
- Digital savvy: Envision and drive change for business performance, exploiting digital technology trends as innovation opportunities. This competency consists of, but not limited to, Big Data Analytics and tools, cloud computing and virtualization, mobile application and development, complex business systems, web development and tools, IT architecture and platform architecture, security skills, ERP systems and social media. The details of e-Leadership or digital leadership competencies are illustrated in Figure 3.
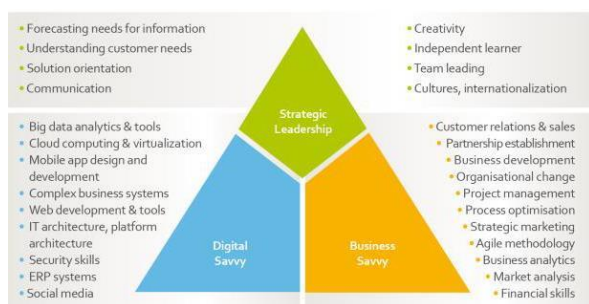


Fig. 3.   e-Leadership competencies.

### E. Digital Transformation

Digital transformation has been defined [22-23] as new digital technologies such as mobile technologies, social media, implanted devices or analytics that are integrated into all parts of business or an organization, fundamentally changing how business operates and value is delivered. This is achieved by restructuring operations, improving customer experience, and improving operations or creating new business prototypes, thereby enabling major business improvements.

Digital transformation, also called digitalization, is on the agenda of all contemporary organizations as technological innovation accelerates and continues to influence everyday life and business as a technology-driven that ultimately enables business improvement disrupts change process that affects every aspect of the organization [23].

Berman defines digitalization (also referred to as "digital transformation" in this study) as a set of complementary activities– reshaping customer value propositions and transforming their operations using digital technologies for greater customer interaction and collaboration. In addition, digital transformation refers to a process where IT is applied in different areas of the organization with the intent to improve their operations [24]. In the same vein, Shaughnessy describes digital transformation as an organization-wide endeavor which involves a variety of technical and cultural changes [25]. According to Horlacher et al., digital transformation refers to firms' use of such technologies as social media, mobile, analytics or embedded devices with the aim of maximizing customer experience or enabling the design and adoption of new business models [26].

Overall, digital transformation requires profound changes in the business models of the organization, and its processes, resources, operational methods and objectives, and culture [27]. At a high level, digital transformation can be defined using digital technologies to make profound changes in society and industries [28]. In lower level, such as an organization level, digital transformation can be defined as organizations innovating ways to use digital technologies to drive better operational performance [29].

### F. Digital Transformation in Public Sector

In public sector, digital transformation is a holistic effort to revise core processes and services of government beyond the traditional digitization efforts. The digital transformation of a public sector organization is based on the digitalization of business processes of the organization. It evolves along a continuum of transition from analog to digital to a full stack review of policies, current processes, and user needs and results in a complete revision of the existing and the creation of new digital services. The outcome of digital transformation efforts focuses among others on the satisfaction of user needs, new forms of service delivery, and the expansion of the user base [30]. Recently, public organizations found themselves under pressure from political leaders and citizens to digitally transform the provision of their services.

In the general discourse on digitalization in the public sector, digital government is considered to be a facilitator or even a driver of transformation [31]. Digital government is often seen as an enabler or even driver of transformation of public administration, with the objective of creating public value. Digital government concerns the use of information technology to improve government operations and serving their citizens. Hence, digital government is accounted as a facilitator and a key driver of this digital transformation [32].

In the public sector literature, changes in service delivery, particularly in terms of e-government, the focus is

not on the creation of new business models but rather on efforts to make service delivery more efficient and accessible to citizens [33] which is the improvement of services and service delivery leading to increases in government efficiency [34].

Digital transformation approaches outside the public sector are changing citizens' expectations of public administration's need to deliver high-value, real-time digital services. Triggered by supranational agreements, such as the "Tallinn Declaration on e-Government" [35], governments are changing their mode of operation in order to improve service delivery, be more efficient and effective in their designs, and achieve objectives such as increased transparency, interoperability, and citizen satisfaction.

According to European Commission, digital transformation in the public sector means new ways of working with stakeholders, building new frameworks of service delivery and creating new forms of relationships [36]. Moreover, the public services will be on be digitally transformed by using new technologies, focusing in particular on achieving an improvement of processes, relationships and services. Results of digital transformation in the public sector consists of new services, new products, new processes, new skills, improved services, improved processes, better relationships, policies, digital environment, value creation, organizational change, digital society and democratic principles [37].

### G. Digital Transformation in Organization Strategy, Business Model and Organization Structure, Operation Structure, Operation Processes, Customer Experience and New Growth

Fitzgerald et. al [38] define digital transformation as, "the use of new digital technologies (social media, mobile, analytics or embedded devices) to enable major business improvements such as enhancing customer experience, streamlining operations, or creating new business models." Liu et. al [39] argue that digital transformation is "as an organizational transformation that integrates digital technologies and business processes in a digital economy." Singh & Hess [21] explain that a digital transformation must consider how advances in digital technologies can bring about changes in an organization's business model, organizational structures and processes. Berman [24] argues that the key transformational opportunities are: (i) creating new business models; (ii) improving operational processes; and (iii) enhancing customer experiences. Ezeokoli et. al. notices that several studies have articulated digital transformation drivers as: Profitability and new revenue growth, customer satisfaction, increased operational efficiency, convenience and the same high-quality technical standard, increase business agility and increase employee productivity and competitive advantage [40].

Hence, digital transformation in terms of organization strategy includes improvement of strategy and operations of public sector organizations [27], [41], improvement of financial planning, work follow-up, analysis and report [42].

Digital transformation in the aspects of business model and organization structure/core includes establishment and improvement of digital infrastructure for service readiness [43], establishment of a new digital department to respond to the needs of citizens and external organizations [44] and increase of cooperation and empowerment for public sector officials for better services to citizens and external organizations [45].

Digital transformation with regard to operation process comprises increase of efficiency in work processes or procedures in public sector operation for citizens services [46], enhancement of organization's ability to develop digital technology workforce competency [43], [47], reduction of gap in using digital technology of citizens and external organizations that use the services [48] and increase of engagement of public sector officials to their organizations [49].

Digital transformation concerning customer experience covers utilization of digital technology such as mobile applications to correspond to citizens and external organizations [50], increase service usage and accessibility to services for citizens and external organizations [51], creation of products/services directly correspond to requirements of citizens and external organizations for better satisfaction and relationship [52] and increase choices and decisions on products/services for citizens and external organizations [43], [52].

Digital transformation in the matter of new growth involves increase opportunity to provide services and ability to develop new services for citizens and external organizations [53-54], create competitive advantage of the public organization [22], [55], strengthen country's economic growth and be a regional economic center [56-57], increase ability of organization to create innovation [52-53], enhance online/e-Commerce service capability to government organizations, business sector and citizens and increase potential of public sector to strengthen the business sector [58].

### H. Digital Transformation Needs Digital Leadership

High-performing leaders in today's day and age need more diverse skills and competencies than before. However, most organizations have not progressed fast enough to encourage leadership growth and development in existing and future digital leaders [9].

In addition, as leadership's role in digital transformation is crucial to every aspect since it decides the strategy, culture, and skills of its employees and plays a key role in the decision making to take the organization forward in this digital age [18], therefore, leadership for digital transformation is not about to drive technology alone, key components of the leadership skills in the digital age are required to drive successful digital transformation for organizations by doing the right things for the strategic success of digitalization for the enterprise and its business ecosystem" [18],[59].

Furthermore, from the study of Rogers, it was found that transformation is fundamentally not about technology, but about strategy, meaning that senior leadership teams must find ways to capitalize on new and unexpected business model innovations that optimize customer needs and experiences [65]. A strategy is as much important than technology to go through digital transformation and leaders establish strategies. By showing examples, leaders will be able to direct all their employees in the right direction [66].

Having a good digital strategy has also been argued by [21], [60], as being key to successful digital transformation, as it drives better operational performance. Kane [61] and Kohnke [62] bring to the forefront the fact that digital transformation is not only about technology, but also in the implementation of a clearly defined strategy and leadership to drive the right culture to change and adapt to the new. Having the right, risk-averse culture is challenging and requires leadership to have a different mind-set when it comes to new ways in digital transformation according to Kane [61].

According to Sainger [63], "Digital Transformation is not possible without a leader who creates the platform for it and drives

stakeholders towards action. It is the leader who gives a thoughtful application of technology to drive a sustainable business success" [63]. In addition, as elaborated by Tiekam [18], traditional leadership skills such as cognitive skills, business skills, influencing/interpersonal skills, and strategic skills were relevant for successful digital transformation. Last but not least, the key digital leadership skills identified as necessary include an understanding of technology, a leader's ability to learn from failure, resilience and the ability to stand up for one's beliefs, and the ability to collaborate [64].

As noted earlier, the e-Leadership skills for the high-tech or digital economy of the European Commission consisting of strategic leadership, business leadership and digital technology leadership should be able to cover the competencies needed for digital leaders to drive digital transformation [17], however, as the world has been entering in the era of digital technology such as cloud computing, Big Data and Analytics, IoTs, mobile, social and cybersecurity, particularly in the aspects of Big Data as this virtual realm offers a level of intimacy regarding opinion and social interaction, dealing with "Big Data" raises not only ethical issues but also questions relating to the expertise required to gather, analyze, and interpret this data [19].

In addition, the study of Human reminds us that personal data protection is multidimensional: Human-centric (H), Accountable (A), Lawful (L), and Ethical (E) (or HALE), personal data protection and consent-obtaining frameworks and mechanisms should be co-created by considering different interdisciplinary i.e., cognitive, economic, legal, technical, societal, and, most importantly, ethical perspectives as this brings to the required competency of digital leadership as ethics as well [20]. As a result, in this research, ethics is required to be one of the key competencies for strategic digital leadership besides strategic leadership, business leadership and digital technology leadership.

### I. Strategic Digital Leadership Competencies for Digital Transformation in The Public Sector

Hence, the organization does require the strategic digital leadership competencies containing of soft skills, culture, people development, cognitive skills, business skills, influencing/interpersonal skills, and strategic skills including ethics and integrity for successful digital transformation.

In conclusion, the key components of strategic digital leadership for digital transformation in public sector could consist of, in terms of strategic digital leadership competency, strategic thinking and overall (holistic) thinking skill, planning and organizing skills, analytical and critical thinking skills, problem solving and decision making skills, interpersonal skills, people development skills, team leading skills, self- control and motivation skills, creativity and innovation skills and ethics/integrity while the strategic digital leadership competency in terms of business (business process for public sector) competency consists of public sector work analysis and service development, management and strategic public relations for citizen services, project management, business process management, enterprise architecture, organization changes.

Lastly, the strategic digital leadership in terms of technical competency consists of digital technology utilization, digital technology application (Cloud computing, IoTs, Augmented Reality (AR) and Virtual Reality (VR) for cybersecurity

management, digital technology development, web design and development for mobile application and IT/digital platform architecture.

Digital transformation of public sector could be concluded in the areas of organization strategy, business/core structure, operation process, user experience, and new growth which the details of each component are described previously.

### J. Sustainable Development Goals

In September 2015, heads of state and government agreed to set the world on a path towards sustainable development through the adoption of the 2030 agenda for sustainable development. This agenda includes 17 SDGs, as shown in Figure 4, which set out quantitative objectives across the 3 pillars of sustainability which are the social, the economic, and environmental dimensions of sustainable development – all to be achieved by 2030 [67]. The goals provide a framework for shared action "for people, planet and prosperity," to be implemented by "all countries and all stakeholders, acting in collaborative partnership."

The 17 SDGs form a cohesive and integrated package of global aspirations the world commits to achieving by 2030 by addressing the most pressing global challenges of our time, calling upon collaborative partnerships across and between countries to balance the three dimensions of sustainable development - economic growth, environmental sustainability, and social inclusion. The 17 SDGs components are shown below in Figure 4.



Fig. 4. The sustainable development goals (SDGs).

With the Information Technology (IT) or Information and Communication Technology (ICT) capabilities to solve the issues on the three aspects of sustainability including economy, society and environment mentioned in the previous section, the ICT/DT such as Cloud, Big Data, analytics, social, mobility and security-enabled world will be cleaner, healthier and more prosperous, with greater opportunities for individuals everywhere as aimed in the SDGs.

### K. Digital Economy

The term "digital economy" refers specifically to the recent and still largely unrealized transformation of all sectors of the economy by the computer-enabled digitization of information [68]. Digital economy is the recent way of doing business with the help of ICT, especially the Internet. It is a new economy represented by the inclusion of technology and digital information. The digital economy is a dominant force in today's economy, and is sometimes called the new economy or the internet economy.

There is an opportunity for a country to transform the economy and to contribute to the development of the digital economy [69]. The digital economy accounts for something like 1.5% of employment in developing countries as an overall average and makes up around 5% of global GDP and 3% of global employment [68], [70].

For developing countries, there is significant promise that the digital economy will boost economic growth, raise productivity of capital and labor, lower transaction costs and facilitate access to global markets [71]. It was expected that the digital economy is growing 15-25% per year in emerging markets [72].

*L. Sustainable Digital Economy*

Digital transformation is defined as the increased connectivity and networking of digital technologies to enhance communication, services, and trade between people, organizations, and things, has been posited as both an emerging opportunity and as a challenge to the United Nations (UN) Global Sustainable Development Goals (SDGs), comprising 17 goals and 169 targets or objectives [73].

The growth and maturation of the digital world, where an increasing scale of individual and communal activities are being recorded, digitized, and analyzed for future technological improvement, is creating unique opportunities to enhance social and environmental well-being, and further improve global standards of living while preserving and improving environmental health for future generation [74-75]. A sustainable digital economy will depend on rapidly evolving governance frameworks that enable societies to anticipate and shape the impact of emerging technologies and react quickly to changing conditions [76].

Besides the conventional 3 pillars to support sustainability which are economy, society and environment, in this research, ethics as the proposed $4^{th}$ pillar of the sustainability could also help maintain sustainability, particularly, as we are in the digital technology age, sustainable and ethical ideas to electronic currencies can help reduce emissions with greater awareness of the population in their financial transactions [77].

In addition, according to Luppicini, the ethical use of genetics, robotics, artificial intelligence and nanotechnology (GRIN) technologies is important in society today, especially in areas where technological advances have a transforming effect on society [78]. Techno-ethics was developed by Moore's Law, which holds that, as the social impact of technological revolutions grows; ethical problems increase. Techno-ethics is holistic in orientation and provides an umbrella for grounding all sub-areas of applied ethics focused on technology related areas of human activity including, business, politics, globalization, health and medicine, and research and development [75], specifically such as: (1) Engineering ethics; (2) Internet ethics and cyber ethics; (3) Educational techno-ethics; (4) Biotech ethics; (5) Media & communications techno-ethics; (6) Professional techno-ethics; (7) Environmental techno-ethics; (8) Nano-ethics; (9) Military techno-ethics and (10) Computer ethics [79].

In particular, with digital technology, for example, Big Data, generation of large volumes of data and the creation of centralized data repositories promise to drive growth across all sectors of society including advancements in SDGs, such as in agriculture, resource allocation, public health, education, and poverty reduction [80]. While this virtual realm offers a level of intimacy regarding opinion and social interaction, dealing with "Big Data" raises not only ethical issues but also questions on how the public sector will gather, analyze, and interpret this data [19].

Furthermore, regarding the personal data protection which is multidimensional and should be co-created by considering different interdisciplinary such as cognitive, legal, technical, societal, economic perspectives and most importantly, ethics [20], as this is a critical requirement for the realization of a sustainable digital economy. Sustainable progress, requires this shift in thinking, including awareness and knowledge of sustainability as well as development of a sustainable mind-set with new thinking patterns, skills, knowledge, morals and ethics [81-82]. Therefore, besides economy, society, environment, the newly proposed pillar of sustainability as the fourth one, which is ethics, is also an important condition for reaching sustainable development [83]. In conclusion, in this research, ethics is used as the fourth pillar, in addition to economy, society and environment, to support sustainability.

*M. Sustainable Digital Economy in Thailand*

In order to use digital technology to create stability, prosperity and sustainability, according to the Thai government policy, Thailand has been undergoing extensive reformation in all socio-economic dimensions. The cabinet has realized the urgent need to leverage digital technology to drive the country forward and therefore assigned the involved ministries to co-develop the Thailand digital economy and society development plan/digital Thailand plan.

The plan acts as a digital blueprint to revolutionize government operations, business practices, and people's lifestyle. The ultimate goal is to bring about social stability as well as economic wealth in Thailand while creating the so-called digital economy and society for everyone, driving the country with digital innovation, and leveraging digital technology to create value in a long-term and sustainable manner. The digital economy, which is a new economy represented by the inclusion of technology and digital information, has become a dominant force in today's economy. In Thailand, there is an urgent need to leverage digital technology to drive the country forward. Therefore, Digital Thailand Plan is developed to generate social stability and economic wealth in Thailand as the followings [84].

1. To translate the government's digital economy policy as delivered before the National Legislative Assembly on 12 September, 2014 into practice.

2. To ensure that all in the government, business, and civil such policy in an integrated and consistent manner.

3. To set a government framework for allocating both human and financial resources required to drive the country towards a digital common goal, without investment redundancies.

The Thailand Digital Economy Plan is divided into four phases to be incorporated over a 20-year period which its goals are to be achieved over this period via six strategies which overlap with but are not quite the same as the goals [85].

Since May 2016, the Thai economy has been guided by the "Thailand 4.0" policy. In addition to encouraging complementing the 2017-2021 National Economic and Social Development Plan (the Twelfth Plan) and other reform agendas such as the Sustainable

Development Goals (SDGs), the Thailand 4.0 policy aims to transform the economy into one that is driven by digital technologies and innovative business practices. Such an approach, it is envisaged, will achieve the core goal of moving Thailand towards a high-income nation that encourages financial and social equality, and ensures that all growth is environmentally sustainable [86].

### N. The Thirteenth National Economic and Social Development Plan (2023-2027)

In formulating the Twelfth Plan (2017- 2021) [87], the Office of the National Economic and Social Development Board (NESDB) adhered to the 20-year National Strategy framework (2017-2036), the country's Sustainable Development Goals (SDGs), the Thailand 4.0 Policy, as well as other reform agendas. Hence, under the Twelfth Plan, the strategies for Thailand's sustainability include the six primary strategies of the 20-year National Strategy: (1) Strengthening and Developing the Potential of Human Capital; (2) Creating a Justice Society and Reducing Inequality; (3) Strengthening Sustainable Economic Development and Competitiveness; (4) Green Growth for Sustainable Development; (5) National Security for the Country's Development towards Prosperity and Sustainability; and (6) Public Administration, Corruption Prevention, and Good Governance in Thai Society.

However, with the implementation of the 12th National Economic and Social Development Plan (NESDB, 2017), which runs from 2017 to 2022, it is likely to fall short of expectations, as the country continues to grapple with the spread of COVID-19. Because the country has been currently dealing with challenges relating to Covid-19, the 12th plan had not been able to quite achieved its goals. The 12th plan, which started on October 1, 2017, aspired for annual economic growth of 5%. In the first two years of the five-year period, the economy increased by an average of 4.1 %, before falling to a 2.3 % rise in 2019 and a 6.1 % contraction in 2020 [88].

After the ending of the 12th National Economy and Society Plan of Thailand, under the 13th National Economy and Society Plan, the target implementation period for the plan is year 2023 to the year 2027 and includes developing human resources for the new world, creating a society of opportunity and fairness, and more. The essence of the plan is outline in the 5 strategic areas as the followings [89]:

1. Restructuring of production, into an economy based on innovation that aligns with technology trends and global trade through promoting research and innovation development.

2. Developing people/ human resources to have the ability and quality of life suitable for the new world through building essential skills for the 21st century, as well as elevating schools and teachers into higher professions.

3. Creating a society of opportunity and fairness by reducing social inequality and increase welfare for the people, and for the underprivileged to have equal access.

4. Creating sustainability for the country through solving environmental problems, and strengthening the industry and green economy.

5. Preparing the country to cope with risks and changes in a new global context.

With the conclusion on the SDGs, the digital economy, the sustainable digital economy, and the on-going sustainable digital economy in Thailand with the implementation of the National Economy and Society Development Plans, the sustainable digital economy in Thailand under the 4 pillars of sustainability, i.e., economy, society, environment and ethics, could be detailed as below.

Firstly, the components under the economy pillar consist of ensuring sustainable consumption, ending poverty and hunger, strengthening global partnership, promoting sustainable economic growth, building confidence in using digital technology, boosting economy with digital technology, transforming organization to digital organization and developing digital manpower [67], [85-88], [89-90].

Secondly, the components under the society pillar consist of achieving gender equality, promoting peaceful society, transforming organization to promote education, creating quality society, building country-wide infrastructure, and ensuring quality education, and implementing global partnership [67], [85], [87], [89-90].

Thirdly, the components under the environment pillar consist of conserving oceans and resources, protecting terrestrial ecosystems, combating climate changes, ensuring availability of water, adopting digital technology for energy saving, promoting environmental awareness and ensuring access to sustainable energy [67], [75-76], [87], [89], [91-95].

Finally, the components under the ethics pillar consist of transforming into an organization with good governance, enhancing systemic work process in organization, using code of ethics, using ethical auditing system in organization and using digital technology to prevent corrupting and misconduct [87], [89].

## III. MATERIALS AND METHODS

### A. Research Process

In this research, in Figure 5, the process from step 1 – step 14 is designed to use the combination of research methodologies of both qualitative and quantitative research with documentary research and content analysis which were conducted through the research step 2 and step 14, particularly in step 3 which the list of contents after performing documentary research method in step 2, i.e. 1) Strategic digital leadership competencies for digital transformation in public sector 2) Digital transformation in public sector; and 3) Sustainable digital economy were created along with its components as described previously.

Then the research questionnaire was constructed and verified through step 4–6 by conducting the in-depth interview with the 20 key stakeholders in public sector from different organizations and was also verified its validity and reliability by using the Index of Item-objective congruence (IOC) with the value $\geq$ 0.8 and the Cronbach Alpha Coefficient method with the confidence level at 0.93 [96].
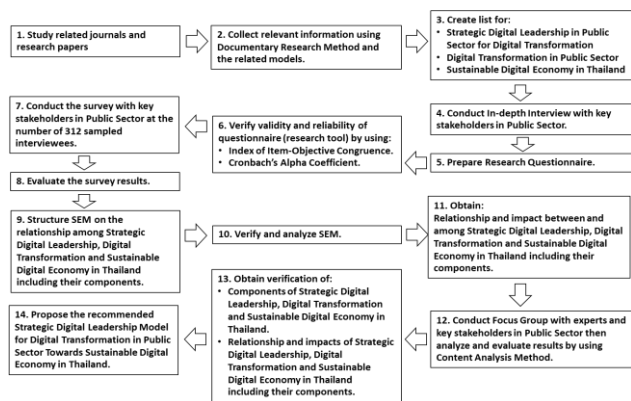
Fig. 5. Diagram of research flow.

On the basis of the existing digital government literature, this research was conducted by using a semi-structured interview guide for the expert interviews. Forty interviews were done with experts knowledgeable about digital transformation projects between January and March 2022. The experts included public managers on the national, regional, and municipal government levels, IT service providers and enterprises working only for government clients, quasi-government employees from consultancies and government officials.

In the step 7, the survey was conducted with 312 interviewees in public sector organizations which are Ministry of Higher Education Science and Innovation, Ministry of Education, Ministry of Interior, Ministry of Defense, Ministry of Public Health, Ministry of Digital Economy and Society, major State Enterprises, Defense Technology Institute, Thailand Professional Qualification Institute and etc., by having them assign the five-points Likert scale in the box of questionnaire they see that it should reflect ranging from Totally agreed (5), Strongly agreed (4), Agreed (3), Somewhat disagreed (2) and Totally disagreed (1). Then, from step 8 – 13, the results from the survey were used to structure the structural equation modeling (SEM) which is a technique combining both path analysis (PA) and confirmatory factor analysis (CFA) for testing hypotheses regarding the relationship between multiple latent variables simultaneously.

The SEM was then used to verify 1) relationship among strategic digital leadership competencies for digital transformation, 2) digital transformation and 3) sustainable digital economy and the related components of each three nodes. Finally, in step 14, the proposed recommendation to the requirements for strategic digital leadership competency development framework in public sector for digital transformation towards sustainable digital economy in Thailand was concluded.

Likert Scale was adopted, which consists of five degrees to determine how much the responders agree or disagrees with each statement in the questionnaire as shown in the Table 1.

TABLE I. LINKERT SCALE

| Scale | Degree |
|---|---|
| Strongly Agree | 5 |
| Agree | 4 |
| Neutral | 3 |
| Disagree | 2 |
| Strongly Disagree | 1 |

To interpret Likert scale results, weighted mean to represent each question was computed. The Table 2 shows the level of agreement associated with each weighted average mean range [97].

TABLE II. WEIGHTED MEAN-LEVEL OF AGREEMENT

| Weighted Mean ($\bar{X}$) | Level of Agreement |
|---|---|
| More than 4.2 - 5 | Very High |
| More than 3.4 – 4.2 | High |
| More than 2.6 -3.4 | Average |
| More than 1.8 – 2.6 | Low |
| 1.8 and less | Very Low |

*B. Research Model and Hypotheses*

In accordance with the research objectives stated above and consistent with the previous related literature, this study was tested on the relationship among strategic digital leadership competency, digital transformation in public sector and sustainable digital economy in Thailand with the following hypotheses, then analyzed and finally confirmed.

H1: Strategic digital leadership will have significant influence on digital transformation of organizations.

H2: Digital transformation will have significant influence on sustainable digital economy.

H3: Strategic digital leadership will have least influence or will not have direct significant influence on sustainable digital economy.

The above hypotheses give rise to the research model for the study, portrayed below in Figure 6, which needs to be tested and analyzed by employing SEM approach in this paper.
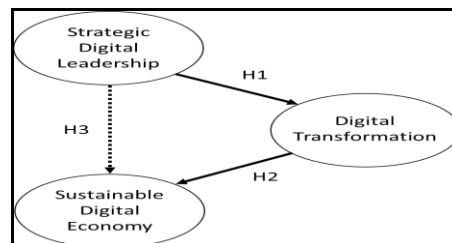


Fig. 6. Research model and hypotheses.

*C. Research Findings*

The validation component analysis with AMOS program in this research was conducted to verify the conformity and coherence of individual model elements in the structural equation model which is an analysis of the relationship between latent variables and observable variables. Hence, the correlation was tested between 3 latent variables and 12 observable variables. The authors analyzed the confirmatory components with AMOS program from a total of 312 samples as shown in Figure 7.

From the analysis of the structural equation model of strategic digital leadership model in public sector for digital transformation towards sustainable development of Thailand's digital economy and the consistency test of structure equation model of strategic digital leadership model for digital transformation towards sustainable development of Thailand's digital economy based on assumptions and empirical data, it was found that the model was consistent with the empirical data by considering the statistical values which are assessed in harmony of the model with the

following empirical data: Chi-square = 23.997, degree of freedom (df) = 15, relative chi-square = 1.600, statistical significance (p-value) = 0.065, Conformity Index Goodness of Fit Index: GFI is 0.988, NFI is 0.994, TLI is 0.990, Comparative Fit Index (CFI) is 0.998, Root Mean Square Error of Approximation (RMSEA) is 0.044 and RMR is 0.010.
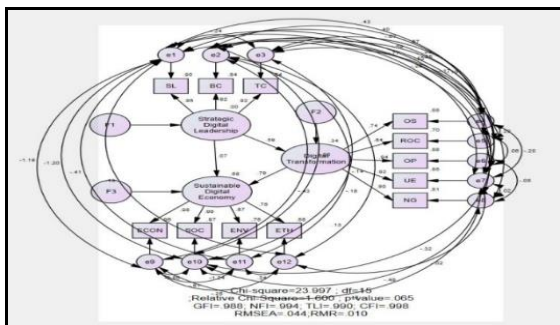


Fig. 7. Factors affecting strategic digital leadership competency, digital transformation, and sustainable digital economy development of Thailand.

TABLE III. CONFORMITY VALUE OF THE MEASUREMENT MODEL

| SEM Model Index | Values | Criteria | Results |
|---|---|---|---|
| Chi-square | 23.997 | | Pass |
| df | 15.00 | | Pass |
| P-value | 0.065 | $\geq 0.05$ | Pass |
| Relative Chi-square | 1.600 | $< 2.00$ | Pass |
| GFI | 0.988 | $\geq 0.95$ | Pass |
| NFI | 0.994 | $\geq 0.95$ | Pass |
| TLI | 0.990 | $\geq 0.95$ | Pass |
| CFI | 0.998 | $\geq 0.95$ | Pass |
| RMSEA | 0.044 | $\leq 0.05$ | Pass |
| RMR | 0.010 | $\leq 0.05$ | Pass |

From the Table 3, it was found that the statistical significance level (p) had a statistical value of 0.065, which was higher than the specified threshold 0.05, so it was considered that it passed the standard. The harmonization index (GFI) of 0.988 statistic value is above the specified threshold indicates that the model is consistent with the empirical data. The relative harmony index (CFI) was 0.998 more than the specified statistic, indicating that the model was consistent. and the estimated mean error index (RMSEA) had a static value of .044 less than .05, indicating that the model was very consistent and fitted [98-101].

When considering Bartlett's test of sphericity, it was found that is equal to 3882.137 with df = 66 and p = 0.000 while the correlation coefficient matrix was not an identity matrix at the .01 level. There is sufficient correlation to be able to analyze the composition consistent with the analysis results. Kaiser-Mayer-Olkin (KMO) which is close to 1 (0.930) is consistent with the research model and the empirical data, since the index value is 0.80 or higher, indicating that the data is very well suited for factor analysis.
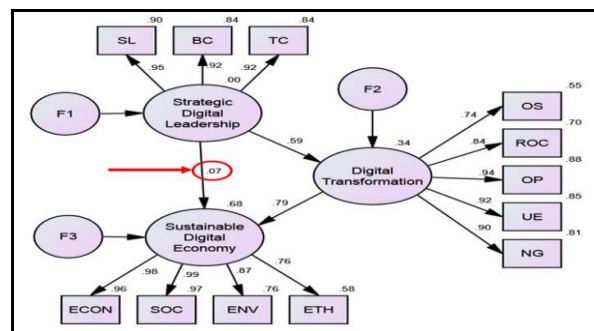


Fig. 8. The results of the analysis of the relevant causal relationship model between strategic digital leadership competency, digital transformation and sustainable digital economy development of Thailand.

(Chi-square = 23.997, df = 15, P = 0.065, Relative Chi-square = 1.600, GFI = 0. 988, NFI = 0.994, TLI = 0.990, CFI = 0.998, RMSEA = 0.044, RMR = 0.010).

As per the finalized structural equation model in Figure 8, the model shows relationship among the 3 latent variables which are strategic digital leadership competency in public sector, digital transformation in public sector and sustainable digital economy in Thailand. From the structure equation model in the Figure 8, there are 3 latent variables which are strategic digital leadership competencies, digital transformation and sustainable digital economy and 12 observed variables which are strategic Leadership competencies (SL), business process competencies (BC), technology competencies (TC), organization strategy (OS), restructure of core/structure of organization (ROC), operation process (OP), user experience (UE), new growth (NG), economy (ECON), society (SOC), environment (ENV) and ethics (ETH).

In the large scope on the relationship among strategic digital leadership, digital transformation and sustainable digital economy, as per the Figure 8, it is found that the factor loading of the path from the strategic digital leadership to the digital transformation is equal to 0.59, from the digital transformation to the sustainable digital economy is 0.79 and from the strategic digital leadership to sustainable digital economy is 0.07.

TABLE IV. FACTOR LOADING VALUES OF LATENT VARIABLES AND OBSERVED VARIABLES

| Latent Variables | Observed Variables | Standardized Regression Weight (Estimated) | $R^2$ |
|---|---|---|---|
| Strategic Digital Leadership | SL | 0.95 | 0.90 |
| | BC | 0.92 | 0.84 |
| | TC | 0.92 | 0.84 |
| Digital Transformation | OP | 0.94 | 0.88 |
| | UE | 0.92 | 0.85 |
| | NG | 0.90 | 0.81 |
| | ROC | 0.84 | 0.70 |
| | OS | 0.74 | 0.55 |
| Sustainable Digital Economy | SOC | 0.99 | 0.97 |
| | ECON | 0.98 | 0.96 |
| | ENV | 0.87 | 0.76 |
| | ETH | 0.76 | 0.58 |

*D. Path Analysis*

From the hypothesis in the Figure 6 and from the structural equation model shown relationship between concerned latent variables and observed variables in the Figure 8, especially the relationship between each 3 latent variables i.e., strategic digital leadership, digital transformation and sustainable digital economy, the hypothesis could be proven its validation as below.

H1: Strategic digital leadership has significant influence on digital transformation of organizations is valid since the loading factor between the two latent variables is 0.59.

H2: Digital transformation has significant influence on sustainable digital economy is valid since the loading factor between the two latent variables is 0.79.

H3: Strategic digital leadership has least influence or does not have direct significant influence on sustainable digital economy is valid since the loading factor between the two latent variables is 0.07.

The details of the results above will be further elaborated in the next session.

From the Table 4, the top three observed variables with their factor loadings of the 3 latent variables are displayed in ascending order. In case of strategic digital leadership, the top 3 observed variables in descending order are strategic leadership competency (SL) (FL=0.95), business process competency (BC) (FL=0.92) and technology competency (TC) (FL=0.92). For digital transformation, the top 3 observed variables in descending order are operation process (OP) (FL=0.94), user experience (UE) (FL=0.92) and new growth (NG) (FL=0.90). And in case of sustainable digital economy, the top 3 Observed Variables in descending order are society (SOC) (FL=0.99), economy (ECON) (FL=0.98) and environment (ENV) (FL=0.87).

Regarding the details of expected components of each 12 observed variables which the interviewees from the public sector organizations see as the most important competencies they would like to have, they are displayed in the top 3 components (only the Table 8 has 2 items) listed in descending order with the statistical values, Mean and S.D. with criteria reference to the Likert Scales as shown below in the Table 5 to the Table 16 accordingly.

Concerning competency gap analysis which is a comparison between the mean of expected competencies public sector organizations would like to have or see that these competencies are important and the same competencies the organizations currently have their abilities to perform for the competencies of strategic leadership, business process and technology are calculated by using the equations (1) – (6) while the results are shown in the Table 17–19 and in the Figure 9–11 accordingly.

Finally, and mostly important, from the results above, the training priority competencies of the organizations evaluated by the highest gap values of the pairs of expected competencies compared with the current competencies are obtained and shown in descending order in the Table 20–22.

TABLE V.   ANALYSIS ON STRATEGIC LEADERSHIP COMPETENCY

| Strategic Leadership Competency | Statistic Values | | |
|---|---|---|---|
| | $\bar{\text{X}}$ | S.D. | Inter-pretation |
| 1. Self-control and Personal Motivation Skills. | 4.40 | 0.70 | Very High |

| | | | |
|---|---|---|---|
| 2. Problem Solving and Decision-Making Skills. | 4.39 | 0.70 | Very High |
| 3. Integrity and Moral and Ethics Skills. | 4.39 | 0.70 | Very High |
| 4. Initiative, Creativity and Innovation Skills. | 4.39 | 0.72 | Very High |
| 5. Holistic Thinking and Strategic Thinking Skills. | 4.38 | 0.69 | Very High |
| 6. Motivation and Team Leading Skills. | 4.38 | 0.71 | Very High |
| 7. Planning and Organizing Skills. | 4.37 | 0.69 | Very High |
| 8. Human Resource Development and Interpersonal Skills. | 4.35 | 0.70 | Very High |
| 9. Analytical Thinking and Critical Thinking Skills. | 4.35 | 0.73 | Very High |
| **Overall Average** | 4.38 | 0.70 | Very High |

TABLE VI.   ANALYSIS ON BUSINESS PROCESS COMPETENCY

| Business Process Competency | Statistic Values | | |
|---|---|---|---|
| | $\bar{\text{X}}$ | S.D. | Inter-pretation |
| 1. Organization changes for public sector process efficiency improvement. | 4.41 | 0.70 | Very High |
| 2. Project Management skills for fast changing digital landscape and citizens' needs. | 4.36 | 0.72 | Very High |
| 3. Public sector work process analysis and service development including establishment of cooperation in both public and private sectors. | 4.32 | 0.71 | Very High |
| 4. Organization Enterprise Architecture for Complex Business Systems. | 4.32 | 0.75 | Very High |
| 5. Management approach and strategic PR in public services requiring analysis of services and management of citizens services and relations. | 4.31 | 0.72 | Very High |
| 6. Organization business process management for sustainable development. | 4.31 | 0.74 | Very High |
| **Overall Average** | 4.34 | 0.72 | Very High |

TABLE VII.   ANALYSIS ON TECHNOLOGY COMPETENCY

| Technology Competency | Statistic Values | | |
|---|---|---|---|
| | $\bar{\text{X}}$ | S.D. | Inter-pretation |
| 1. Digital Technology Utilization for Sustainable Development in economy, society and environment and Human Resource Development. | 4.38 | 0.71 | Very High |
| 2. Digital Technology Applications e.g. IoT, Cloud, Social, AR/VR for Cybersecurity Management. | 4.38 | 0.75 | Very High |
| 3. Web Design and Development for mobile products/services applications. | 4.34 | 0.77 | Very High |
| 4. IT/Digital Platform Architecture for business operation. | 4.31 | 0.76 | Very High |
| 5. Digital Technology Development. | 4.21 | 0.84 | Very High |
| **Overall Average** | 4.32 | 0.77 | Very High |

TABLE VIII.   ANALYSIS ON DIGITAL TRANSFORMATION: ORGANIZATION STRATEGY

| Impacts from Digital Transformation: Organization Strategy | Statistic Values | | |
|---|---|---|---|
| | $\bar{\text{X}}$ | S.D. | Inter-pretation |
| 1. Improvement of strategy and operations of public sector | 4.23 | 0.75 | Very High |

| | | | |
|---|---|---|---|
| organizations. | | | |
| 2. Improvement of financial planning, work follow-up, analysis, and report. | 4.15 | 0.80 | High |
| **Overall Average** | 4.19 | 0.78 | High |

TABLE IX.   ANALYSIS ON DIGITAL TRANSFORMATION: ORGANIZATION CORE AND STRUCTURE

| Impacts from digital transformation: Organization core and structure | Statistic Values | | |
|---|---|---|---|
| | $\bar{x}$ | S.D. | Inter-pretation |
| 1. Establishment and improvement of digital infrastructure for service readiness. | 4.08 | 0.79 | High |
| 2. Increase of cooperation and empowerment for public sector officials for better services to citizens and external organizations. | 4.00 | 0.79 | High |
| 3. Establishment of a new Digital department to respond to the needs of citizens and external organizations. | 3.92 | 0.93 | High |
| **Overall Average** | 4.00 | 0.84 | High |

TABLE X.   ANALYSIS ON DIGITAL TRANSFORMATION: ORGANIZATION BUSINESS PROCESS

| Impacts from digital transformation: Organization Business Process | Statistic Values | | |
|---|---|---|---|
| | $\bar{x}$ | S.D. | Inter-pretation |
| 1. Enhancement of organization's ability to develop digital technology workforce competency. | 4.16 | 0.80 | High |
| 2. Increase of efficiency in work processes or procedures in public sector operation for citizens services. | 4.15 | 0.81 | High |
| 3. Reduction of gap in using digital technology of citizens and external organizations that use the services. | 4.08 | 0.80 | High |
| 4. Increase of engagement of public sector officials to their organizations. | 3.93 | .0.84 | High |
| **Overall Average** | **4.08** | **0.81** | **High** |

TABLE XI.   ANALYSIS ON DIGITAL TRANSFORMATION: USER EXPERIENCE

| Impacts from digital transformation: User Experience | Statistic Values | | |
|---|---|---|---|
| | $\bar{x}$ | S.D. | Inter pretation |
| 1. Increase choices and decisions on products/services for        citizens and external organizations | 4.12 | 0.82 | High |
| 2. Utilization of digital technology such as mobile applications to correspond to citizens and external organizations | 4.08 | 0.86 | High |
| 3. Increase service usage and accessibility to services for citizens and external organizations | 4.08 | 0.83 | High |
| 4. Creation of Products/services directly correspond to requirements of citizens and external organizations for better satisfaction and relationship. | 4.06 | 0.84 | High |
| **Overall Average** | **4.08** | **0.84** | **High** |

TABLE XII.   ANALYSIS ON DIGITAL TRANSFORMATION: NEW GROWTH

| Impacts from digital transformation: New growth | Statistic Values | | |
|---|---|---|---|
| | $\bar{x}$ | S.D. | Inter-pretation |
| 1.Increase opportunity to provide services and ability to develop new services for citizens and external organizations. | 4.22 | 0.79 | Very High |
| 2. Enhance online/e-Commerce service capability to government organizations, business sector and citizens. | 4.19 | 0.85. | High |
| 3. Increase ability of organization to create innovation | 4.18 | 0.82 | High |
| 4. Strengthen country's economic growth and be a regional economic center | 4.15 | 0.82 | High |
| 5. Increase potential of public sector to strengthen the business sector | 4.13 | 0.84 | High |
| 6. Create competitive advantage of the public organization. | 4.13 | 0.86 | High |
| **Overall Average** | **4.17** | **0.83** | **High** |

TABLE XIII.   ANALYSIS ON SUSTAINABLE DIGITAL ECONOMY: ECONOMY

| Sustainable Digital Economy: Economy | Statistic Values | | |
|---|---|---|---|
| | $\bar{x}$ | S.D. | Inter pretation |
| 1. Transform organization to a digital organization that is ready to serve people and able to provide people with access to services and products. | 4.03 | 0.87 | High |
| 2. Build confidence in using digital technology by creating security and confidence in transactions for people and all sectors | 4.02 | 0.84 | High |
| 3. Boost the economy with digital technology, drive new S-Curve services, raise competitiveness, build new businesses and create values. | 4.02 | 0.87 | High |
| 4. Develop skilled digital manpower for the digital economy and society. | 4.01 | 0.88 | High |
| 5. Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all including social development and environment protection. | 3.96 | 0.84 | High |
| 6. Strengthen the means of implementation and revitalize the Global Partnership for Sustainable Development. | 3.96 | 0.88 | High |
| 7. Ensure sustainable consumption production patterns. | 3.93 | 0.88 | High |
| 8. End poverty in all its forms everywhere, end hunger, achieve food security and improved nutrition and promote sustainable agriculture, and ensure healthy lives and promote well-being for all at all ages. | 3.74 | 0.96 | High |
| **Overall Average** | **3.96** | **0.88** | **High** |

TABLE XIV.   ANALYSIS ON SUSTAINABLE DIGITAL ECONOMY: SOCIETY

| Sustainable Digital Economy: Society | Statistic Values | | |
|---|---|---|---|
| | $\bar{x}$ | S.D. | Inter-pretation |
| 1. Ensure inclusive and equiTable quality education and promote lifelong learning opportunities for all. | 4.16 | 0.82 | High |
| 2. Transform organization to promotes education, learning and human | 4.15 | 0.81 | High |

| | $\overline{\mathbf{X}}$ | S.D. | Inter-pretation |
|---|---|---|---|
| resource development of the organization. | | | |
| 3. Create quality society and reduce inequality with inclusive digital technology and participation from all sectors of society. Reduce inequality within and among countries. | 4.06 | 0.81 | High |
| 4. Strengthen the means of implementation and revitalize the Global Partnership for Sustainable Development. | 4.04 | 0.85 | High |
| 5. Build country-wide high-capacity digital infrastructure while ensuring accessibility, availability, and affordability. | 4.03 | 0.88 | High |
| 6. Strengthen the means of implementation and revitalize the Global Partnership for Sustainable Development. | 4.02 | 0.86 | High |
| 7. Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels. | 3.98 | 0.87 | High |
| **Overall Average** | **4.06** | **0.84** | **High** |

TABLE XV. ANALYSIS ON SUSTAINABLE DIGITAL ECONOMY: ENVIRONMENT

| Sustainable Digital Economy: Environment | Statistic Values | | |
|---|---|---|---|
| | $\overline{\mathbf{X}}$ | S.D. | Inter-pretation |
| 1. Adopt digital technology for energy-saving and environmental protection measures for sustainable development. | 4.00 | 0.91 | High |
| 2. Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss. | 3.91 | 0.97 | High |
| 3. Ensure availability and sustainable management of water and sanitation for all. | 3.90 | 0.97 | High |
| 4. Promote environmental awareness in every step of the product life cycle. | 3.88 | 0.98 | High |
| 5. Conserve and sustainably use the oceans, seas and marine resources for sustainable development. | 3.87 | 1.01 | High |
| 6. Take urgent action to combat climate change and its impacts. | 3.83 | 1.01 | High |
| 7. Ensure access to affordable, reliable, sustainable and modern energy for all. | 3.81 | 1.07 | High |
| **Overall Average** | **3.89** | **0.99** | **High** |

TABLE XVI. ANALYSIS ON SUSTAINABLE DIGITAL ECONOMY: ETHICS

| Impacts from digital transformation: Ethics | Statistic Values | | |
|---|---|---|---|
| | $\overline{\mathbf{X}}$ | S.D. | Inter-pretation |
| 1. Enhancing the organization's work processes to be systematic and ethical standards. | 4.08 | 0.91 | High |
| 2. Transform into an organization with good governance, transparency both inside and outside the organization and able to prevent and suppress corruption and | 4.07 | 0.92 | High |

| | $\overline{\mathbf{X}}$ | S.D. | Inter-pretation |
|---|---|---|---|
| misconduct. | | | |
| 3. Use of Code of Ethics in corporate management. | 4.05 | 0.91 | High |
| 4. Use ethical auditing system in the organization for accuracy, transparency and fairness in operation. | 4.04 | 0.93 | High |
| 5. Use digital technology to control work processes for the prevention and suppression of corruption and misconduct. | 4.00 | 0.97 | High |
| **Overall Average** | **4.05** | **0.93** | **High** |

Equations (1)-(6) for gap analysis of strategic leadership competency, business process competency and technology in the Tables 17 – 19 are listed and detailed as below.

$$Gap\ CSL = \left| CSL_{Expected} - CSL_{Current} \right| \quad (1)$$

$$Gap\ CSL_{Avg.} = \frac{\sum_{i=1}^{p} \left| CSL_{Expected} - CSL_{Current} \right|}{N_{CSL.}} \quad (2)$$

Where:

| | | |
|---|---|---|
| $Gap\ CSL$ | = | Gap of strategic leadership competency |
| $CSL_{Expected}$ | = | Strategic leadership competencies the organizations would like to have |
| $CSL_{Current}$ | = | Strategic leadership competencies the organizations currently have their abilities to perform |
| $Gap\ CSL_{Avg.}$ | = | Average of gap of strategic leadership competency |
| $p$ | = | 9 |
| $N_{CSL}$ | = | 9 |

$$Gap\ CBP = \left| CBP_{Expected} - CBP_{Current} \right| \quad (3)$$

$$Gap\ CBP_{Avg.} = \frac{\sum_{i=1}^{q} \left| CBP_{Expected} - CBP_{Current} \right|}{N_{CBP}} \quad (4)$$

Where:

| | | |
|---|---|---|
| $Gap\ CBP$ | = | Gap of business process competency |
| $CBP_{Expected}$ | = | Business process competencies the organizations would like to have |
| $CBP_{Current}$ | = | Business process competencies the organizations currently have their abilities to perform |
| $Gap\ CBP_{Avg.}$ | = | Average of gap of business process competency |
| $q$ | = | 6 |
| $N_{CBP}$ | = | 6 |

$$Gap\ CT = \left| CT_{Expected} - CT_{Current} \right| \quad (5)$$

$$Gap\ CT_{Avg.} = \frac{\sum_{i=1}^{r} \left| CT_{Expected} - CT_{Current} \right|}{N_{CT}} \quad (6)$$

Where:

| | | |
|---|---|---|
| $Gap\ CT$ | = | Gap of technology competency |
| $CT_{Expected}$ | = | Technology competencies the organizations would like to have |
| $CT_{Current}$ | = | Technology competencies the organizations currently have their |

abilities to perform

$Gap\ CT_{Avg.}$ = Average of gap of technology competency

$r$ = 5

$N_{CT}$ = 5

TABLE XVII.   ANALYSIS ON STRATEGIC DIGITAL LEADERSHIP COMPETENCY GAP: STRATEGIC LEADERSHIP COMPETENCY

| Strategic Leadership Competency | Statistic Values | | | |
|---|---|---|---|---|
| | Best Score | Expected | Current | Gap |
| 1. Self-control and Personal Motivation Skills. | 5.00 | 4.40 | 3.82 | 0.58 |
| 2. Problem Solving and Decision-Making Skills. | 5.00 | 4.39 | 3.82 | 0.57 |
| 3. Initiative, Creativity and Innovation Skills. | 5.00 | 4.39 | 3.73 | 0.66 |
| 4. Integrity and Moral and Ethics Skills. | 5.00 | 4.39 | 3.79 | 0.60 |
| 5. Holistic Thinking and Strategic Thinking Skills. | 5.00 | 4.38 | 3.78 | 0.60 |
| 6. Motivation and Team Leading Skills. | 5.00 | 4.38 | 3.78 | 0.55 |
| 7. Planning and Organizing Skills. | 5.00 | 4.37 | 3.82 | 0.55 |
| 8. Human Resource Development and Interpersonal Skills. | 5.00 | 4.35 | 3.76 | 0.59 |
| 9. Analytical Thinking and Critical Thinking Skills. | 5.00 | 4.35 | 3.76 | 0.59 |
| Overall Average | 5.00 | 4.38 | 3.78 | 0.59 |

TABLE XVIII.   ANALYSIS ON STRATEGIC DIGITAL LEADERSHIP COMPETENCY GAP: BUSINESS PROCESS COMPETENCY

| Business Process Competency | Statistic Values | | | |
|---|---|---|---|---|
| | Best Score | Expected | Current | Gap |
| 1. Organization changes for public sector process efficiency improvement. | 5.00 | 4.41 | 3.76 | 0.65 |
| 2. Project Management skills for fast changing digital landscape and citizens' needs. | 5.00 | 4.36 | 3.69 | 0.67 |
| 3. Organization Enterprise Architecture (EA) for Complex Business Systems. | 5.00 | 4.32 | 3.63 | 0.69 |
| 4. Public sector work process analysis and service development including establishment of cooperation in both public and private sectors. | 5.00 | 4.32 | 3.69 | 0.63 |
| 5. Management approach and strategic PR in public services requiring analysis of services and management of citizens services and relations. | 5.00 | 4.31 | 3.74 | 0.57 |
| 6. Organization business process management for sustainable development. | 5.00 | 4.31 | 3.69 | 0.62 |
| Overall Average | 5.00 | 4.34 | 3.70 | 0.64 |

TABLE XIX.   ANALYSIS ON STRATEGIC DIGITAL LEADERSHIP COMPETENCY GAP: TECHNOLOGY COMPETENCY

| Technology Competency | Statistic Values | | | |
|---|---|---|---|---|
| | Best Score | Expected | Current | Gap |
| 1. Digital Technology Applications e.g. IoT, Cloud, Social, AR/VR for Cybersecurity Management. | 5.00 | 4.38 | 3.65 | 0.73 |
| 2. Digital Technology Utilization for Sustainable Development in economy, society and environment and Human Resource Development. | 5.00 | 4.38 | 3.78 | 0.60 |
| 3. Web Design and Development for mobile products/services applications. | 5.00 | 4.34 | 3.70 | 0.64 |
| 4. IT/Digital Platform Architecture for business operation. | 5.00 | 4.31 | 3.64 | 0.67 |
| 5. Digital Technology Development e.g. Big Data, Analytics, AR, VR, AI and Blockchain for Enterprise Resource Planning (ERP) and business operation. | 5.00 | 4.21 | 3.48 | 0.73 |
| Overall Average | 5.00 | 4.32 | 3.65 | 0.67 |
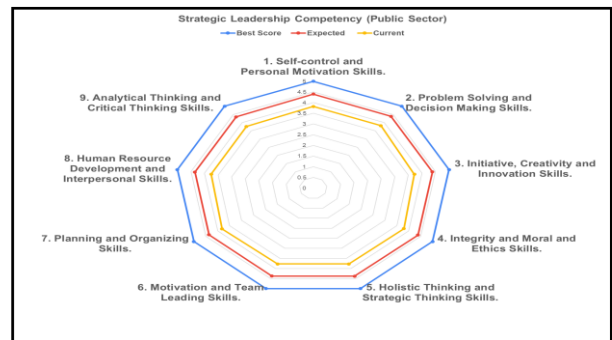


Fig. 9.  Radar chart/spider web chart of the gap analysis of the strategic leadership.



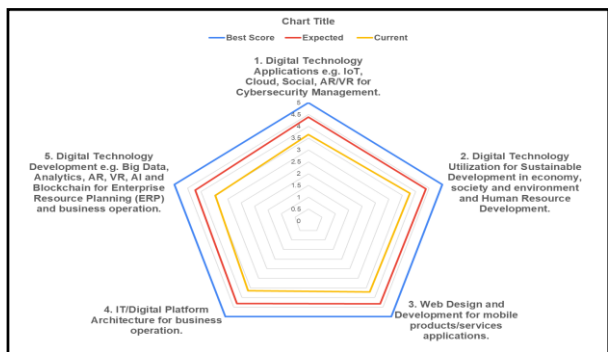Fig. 10. Radar chart/spider web chart of the gap analysis of the business process competency.

Fig. 11. Radar Chart/Spider Web Chart of the Gap Analysis of the Technology competency.

TABLE XX. ANALYSIS ON STRATEGIC DIGITAL LEADERSHIP COMPETENCY TRAINING PRIORITY: STRATEGIC LEADERSHIP COMPETENCY

| Strategic Leadership Competency | Gap |
|---|---|
| 1. Initiative, Creativity and Innovation Skills. | 0.66 |
| 2. Holistic Thinking and Strategic Thinking Skills. | 0.60 |
| 3. Integrity and Moral and Ethics Skills. | 0.60 |
| 4. Human Resource Development and Interpersonal Skills. | 0.59 |
| 5. Analytical Thinking and Critical Thinking Skills. | 0.59 |
| 6. Self-control and Personal Motivation Skills. | 0.58 |
| 7. Problem Solving and Decision Making Skills. | 0.57 |
| 8. Planning and Organizing Skills. | 0.55 |
| 9. Motivation and Team Leading Skills. | 0.55 |
| **Overall Average** | **0.59** |

TABLE XXI. ANALYSIS ON STRATEGIC DIGITAL LEADERSHIP COMPETENCY TRAINING PRIORITY: BUSINESS PROCESS COMPETENCY

| Business Process Competency | Gap |
|---|---|
| 1. Organization Enterprise Architecture (EA) for Complex Business Systems. | 0.69 |
| 2. Project Management skills for fast changing digital landscape and citizens' needs. | 0.67 |
| 3. Organization changes for public sector process efficiency improvement. | 0.65 |
| 4. Public sector work process analysis and service development including establishment of cooperation in both public and private sectors. | 0.63 |
| 5. Organization business process management for sustainable development | 0.62 |
| 6. Management approach and strategic PR in public services requiring analysis of services and management of citizens services and relations. | 0.57 |
| **Overall Average** | **0.64** |

TABLE XXII. ANALYSIS ON STRATEGIC DIGITAL LEADERSHIP COMPETENCY TRAINING PRIORITY: TECHNOLOGY COMPETENCY

| Technology Competency | Gap |
|---|---|
| 1. Digital Technology Applications, e.g., IoT, Cloud, Social, AR/VR for Cybersecurity Management. | 0.73 |
| 2. Digital Technology Development e.g. Big Data, Analytics, AR, VR, AI and Blockchain for Enterprise Resource Planning (ERP) and business operation. | 0.73 |
| 3. IT/Digital Platform Architecture for business operation. | 0.67 |
| 4. Web Design and Development for mobile products/services applications. | 0.64 |

| | |
|---|---|
| 5. Digital Technology Utilization for Sustainable Development in economy, society and environment and Human Resource Development. | 0.60 |
| **Overall Average** | **0.67** |

## IV. RESULTS AND DISCUSSION

For a causal relationship model of a strategic digital leadership model for digital transformation towards sustainable digital economic development in Thailand through structural equation model analysis (SEM) analysis, from the SEM in the Figure 8 and the factor loading of components of the observed variables and the latent variables in the Table 5 – the Table 16, with the main objectives of public sector is to service the citizens and organizations both in public and private sectors, the research could conclude the results as below.

Overall, on the relationship among the 3 latent variables, in the Figure 8, firstly, between strategic digital leadership and digital transformation, the research is found that the strategic digital leadership has impact on digital transformation with FL = 0.59 which means that, in the public sector, Leadership (strategic digital leadership) could influence the digital transformation of the organizations. Secondly, between digital transformation and sustainable digital economy, it is found that digital transformation has strong impact on sustainable digital economy with FL= 0.79 which means that, with systematic way of digital transformation in the 5 areas, i.e. organization strategy, restructure of core/structure of organizations, operation process, user experience and new growth, digital transformation could drive digital economy to be sustainable.

Lastly and most importantly, on the relationship between strategic digital leadership and sustainable digital economy, it is found that strategic digital leadership has least impact on sustainable digital economy (FL=0.07) which means that strategic digital leadership could not drive the organization to be sustainable directly, however, the leader, in order to achieve sustainable digital economy, the leader must drive organization through systematic digital transformation process. This is very important for any organization as it could not depend on the leader to achieve organization sustainability but needs to have the whole organization go through the digital transformation process first then become sustainable.

Regarding the strategic digital leadership competency, from the Figure 8, its latent variable consisting of the 3 observed variables could be arranged in descending order as per their factor loading (FL) values which are the strategic leadership competency (SL) (FL=0.95), the business process competency (BC) (FL=0.92) and technology competency (TC) (FL=0.92). As a result, the strategic leadership competency plays the most important competency role of strategic digital leadership competency among business process competency and technology competency which implies that the public/government organizations, in order to implement digital transformation successfully, the organizations have to put competency in strategic leadership/strategy as the highest priority among business process and technology competencies.

As the strategic leadership competency is the most crucial among business process competency and technology competency, this research is found that its top 3 expected

competencies the public sector organizations would like to have or see that these competencies are important consist of self-control and personal motivation skills, problem solving and decision-making skills and integrity/moral and ethics.

Concerning the business process competency, the top 3 expected competencies are organization changes skills for public sector process efficiency improvement, project management skills for fast changing digital landscape and citizens' needs and public sector work process analysis and service development skills including establishment of cooperation in both public and private sectors. In addition, on the technology competency, the top 3 expected competencies are digital technology utilization skills for sustainable development and human resource development, digital technology applications skills e.g. IoT, Cloud, social, AR/VR for cybersecurity management and web design and development for mobile products/services applications.

Regarding digital transformation, particularly in the public sector, this research is found that the top 3 observed variables are operation process (FL= 0.94), user experience (FL= 0.92) and new growth (FL=0.90). This is true for government/public organizations which operation process and user experience needs to be improved and transformed to be more flexible to better serve citizens and concerned organizations while new growth means the new services, for examples, mobile applications and government digital service platforms and online/e-Commerce services, need to be added and developed to enhance capability to government organizations to create and increase innovation to deliver new and better services to citizens and external organizations.

Concerning sustainable digital economy, in this public sector case, which the top 3 three observed variables are society, economy and environment accordingly, as per the main objectives of the public organization is to service citizens and organizations in both public and private sectors and to create economy growth, hence society (FL=0.99) is the number one priority for government and economy (FL=0.98) is the next high priority while environment (FL=0.87) and ethics (FL=0.76) are the next priorities consecutively. Hence this means that the research results do reflect the real mission of the public sector organizations which needs to put their concern on providing service to the public, citizens and society.

In further detailed analysis of the sustainable digital economy, while the 3 major pillars such as society, economy and environment have been playing roles on sustainability, however, in this research, it is found that, ethics (FL=0.76) has been proven to be new pillar of sustainability since, as the world now have been entering into the era of using digital technology to transform organizations and nations, the ethical use of digitized data and cybersecurity measure for data privacy and public security will play important roles for safety and stability of the society and the world.

From the gap analysis which is the study of the differences between the expected and the current strategic digital leadership competency consisting of strategic leadership, business process and technology competencies evaluated by using the equations (1) – (6) and the results are shown in the Table 17-19, this research could help the public sector

organizations specify on the pairs of the competencies expected to focus and the current status/situation of the very competencies the organizations have been up to at the moment by comparing the Likert scale values which the higher values of the gaps (difference of Means) are, the competencies need to be put as the higher training priority will be. In addition, the radar chart/spider web chart are also illustrated in the Figure 9-11 which could bring to the further analysis the highest priority training competencies in descending order which have the highest gap between the expected competencies and the current competencies of the organization.

From the radar chart/spider web chart in the Figure 9-11 and the analysis on the key strategic digital leadership competencies in the Table 20–22, the top three strategic digital leadership competencies to be trained for public sector organizations indicated by the largest value of competency gap between the expected and the current strategic digital leadership are shown in descending order. For the strategic leadership competency, the top three training priority competencies are initiative, creativity and innovation skills, holistic thinking and strategic thinking skills and integrity and moral and ethics.

For business process competency, the top three training priority competencies are organization enterprise architecture for complex business systems, project management for fast changing digital technology environment and organization changes for business process efficiency improvement. For technology competency, the top three training priority competencies are digital technology application for cybersecurity management, digital technology development for enterprise resource planning and business operation and IT/digital platform for business operation.

## V. CONCLUSION

In conclusion, this research has opened opportunities to learn on how the public sector and the government organizations, including policy makers, in this digital technology and digital economy era, could leverage the knowledge of the right strategic competencies to train their leaders to digitally transform the organizations in a systematic and proper way to obtain the sustainable organizations to respond to the requirements of society, the growth of economy, the conservation of environment and the ethical and good governance organizations. The key benefits of this research could be summarized as below.

Firstly, strategic digital leadership plays important role in the digital transformation of organizations in the public sector which, when that organization has undergone a systematic digital transformation, will result in the organizations successfully developing sustainable digital economy and society.

Secondly, the training for strategic digital leadership for digital transformation should be focused on the training of the right competencies for strategic leadership and the right strategy of the organization which could answer the requirements of public sector/government organizations as the top training priority while technology and business process competencies should be later aligned for the training accordingly.

Thirdly, leaders alone cannot command or take any action that will drive sustainable economic and social development, but

it has to be done through the digital transformation of that organization in a systematic way for a long-lasting sustainability of the organization.

Fourthly, with the gap analysis between the expected and the current strategic digital leadership competency evaluated by using the equations (1) – (6) and the results are shown in the Tables 17 – 19 and the Figure 9-11, the top three training priority competencies in strategic leadership, business process and technology illustrated in the Tables 20 – 22 could be very useful for the public sector organizations to organize specific training program which is mostly relevant and answers to the present requirements of the organizations for the effective and successful digital transformation.

In addition, as the strategic leadership plays the most important role among the other two competencies, i.e., technology and business competencies, the research could help the government and public policy makers focus on the right strategy for the organizations first rather than investing solely and heavily on digital technology to drive digital transformation as this will help the public sector exercise national budget more appropriately and more efficiently.

And last but not least, in terms of sustainability, it used to only be thinking in the 3 areas: economy, society, and environment, however this innovative study discovered the 4th component that is extremely important in this era of digital technology for sustainability, which is the ethics. This will be the key factor that makes the world in the digital era be able to exist because there must be a consideration of the use of information appropriately and usefully in the non-infringement of personal data, the cyber-attack protection and the use social media properly to the context of that society without violating on the rights of others and threatening the safety of society.

## VI. FUTURE RESEARCH

From this research, the further studies, could be explored on how the government agencies need to be aware of the agency's strategy to fulfill the mission assigned to it with the resources of the nation and the needs of the people that exist at that time. This will help the nation to have digital transformation with efficiency and maximum benefits. It also helps the public organizations and the government to buy technology rationally and will save a lot of national fiscal budget rather than investing solely on purchasing technology for digital transformation. In addition, more detailed studies could be done on specific strategic digital leadership competencies of each specific public organizations which could be vary upon the nature and functions of those organizations, hence this could support the organizations to develop the right competencies for digital transformation towards sustainable digital economy of the organizations in the long run.

Lastly, considering changes to digital leadership roles and styles necessary in the post-COVID-19 era, the future study on the right competencies of strategic digital leadership could be highly relevant as the pandemic accelerated the public sector organizations to shift to remote or hybrid work formats [102-103], for example, a study of academic leadership by Fernandez and Shaw [104] elaborated on leadership in post COVID-19 times.

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