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The management of innovation in the public sector to enhance effective and sustainable public services

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ABSTRACT
This article aims to analyze innovation in public services, including strategies and policies that support innovation development. It also seeks to identify structural and bureaucratic challenges hindering innovation management, while proposing approaches and policy recommendations to foster a sustainable culture of innovation within the public sector. Innovation in the public sector is critically important for advancing public services and public administration in an era were technology and big data play increasingly pivotal roles. Public sector innovation refers to the development and adoption of new technologies and processes in service delivery and administration to boost the efficiency and transparency of government operations. Effective innovation management in the public sector must consider proper resource allocation, risk management, and strategic adaptation to rapidly changing environments. This article discusses the development of strategies and policies that support the adoption of technology in the public sector, examining case studies such as Estonia's e-Government and the adoption of AI in Singapore's civil service, as well as challenges in managing innovation within the Thai public sector. Furthermore, the article analyzes structural issues, the creation of an innovation-oriented culture in government agencies and provides recommendations on developing public sector innovation in Thailand that can lead to sustainability by introducing new approaches to efficiently utilize resources, reduce environmental impact, and improve people's quality of life without compromising the future. and more effective public service delivery.

Introduction

The term "innovation" has its roots in the Latin word innovate, meaning "to renew" or "to modify." It refers to an idea, an object, or a practice that an individual or group of individuals accepts in order to improve upon a predetermined objective, which requires planning and deliberation in its adoption. This aims to enhance people's attitudes and behaviors, thereby elevating their quality of life through modern methods and better systems (Limtasiri, 2013). Innovation comprises three important dimensions: (1) newness, referring to newly developed products, services, or processes-either improved from existing ones or entirely new; (2) economic benefits, signifying that the new development must create commercial value

or added value (Chamchong, 2018); and (3) often relying on modern technology to achieve such innovations.

The term "technology" is derived from the Latin texere, meaning "to weave" or "to construct." In English usage, "techno" refers to "method" and "logy" refers to "the study of," so technology involves the methods, people, and equipment necessary for the production process. Technology itself is a fusion between process and production; without a smart application process, mere tools or equipment bring no benefits in solving problems or running operations (Limtasiri, 2013). Consequently, technology and innovation are closely intertwined: technology serves as a tool that helps develop and improve various aspects, while innovation is the application of new technology or ideas to create value and solve problems. In the public sector, innovation plays a vital role in improving government administration and service delivery. Generally, it can be classified into three main types: (1) process innovation, which involves improving work processes; (2) service innovation, which focuses on developing new methods of service delivery; and (3) policy innovation, which entails designing policies that align with evolving contexts. Effective public sector innovation requires technology, government support, and public participation to produce outcomes that genuinely enhance people's quality of life.

In today's highly advanced technological world, featuring innovations in information and communication technology-everything is interconnected quickly and often in complex ways, yielding high efficiency and impact. As globalization increasingly brings the world together into a "global village," this interconnectedness spans economic, social, and political dimensions (Kenprom, 2015). Rapid advancements in technology lead to increased innovation since technology provides a foundational platform for discovering new solutions.

For instance, Artificial Intelligence (AI) significantly enhances machine efficiency and automation, spawning entirely new products and services (Brynjolfsson & McAfee, 2014). Examples of technology-driven innovation that benefits public administration include:

1) Medical Industry: Medical technologies, such as 3D printing, are used to produce prosthetic devices

and medical equipment with higher quality, thereby improving patient care (Ventola, 2014).

2) Clean Energy: Renewable energy technologies, such as solar panels and wind turbines, are continuously improving, lowering costs, and enabling widespread adoption (REN21, 2021).

3) Digital Industry: High-speed internet and cloud technology support emerging platforms in e-commerce and online communication, increasing business opportunities and access to information (Castells, 2010).

It is evident that innovation is crucial for enhancing public service provision, enabling faster government operations with greater efficiency, and better meeting public demands. Innovation also helps ensure equal access to public services. In the public sector, innovation can strengthen organizational efficiency, transparency, and responsiveness, mitigating corruption and improving trust. It also serves as a key instrument in addressing new societal challenges, such as economic and social transitions, climate change, and disease outbreaks. For instance, during the COVID-19 pandemic in Thailand, government agencies developed the "Mor Chana" application and online vaccine registration systems, enabling citizens to receive accurate information and streamlined public health services. Public sector innovation is not solely about technology; it also encompasses management, policy formation, and citizen participation. Developing effective public sector innovation requires government support, public cooperation, and the strategic application of technology to achieve outcomes that tangibly improve citizens' lives. Innovation is central to making government policies sustainable by creating targeted and effective solutions. For example, in industries like medicine, clean energy, and digital technology, it helps ensure resources are used optimally, waste is reduced, and natural regeneration is promoted. Furthermore, it elevates the quality of life for citizens in various sectors, from public health to education. Most importantly, innovation enables

governments to adapt and respond swiftly to changes in the modern world, all of which are crucial factors for long-term sustainability.

Innovation management in the public sector is essential for boosting efficiency and focusing on outcomes in public service delivery. Management improvements aim to create something new and bring economic benefits by leveraging knowledge, creativity, and digital technology to develop innovations that improve government administration. Doing so helps agencies respond more effectively to public needs, reduce operating costs, increase transparency, and enhance national competitiveness in a rapidly evolving digital era.

The process of cultivating innovation in public organizations comprises:

1) Creating an Innovation-Oriented Organization, which includes:
   1.1) Innovative leadership,
   1.2) A clearly defined vision for innovation, and
   1.3) Development of personnel who champion innovation.
2) Implementing Process Innovation in the Public Sector, which entails:
   2.1) Generating creative ideas to overcome obstacles for the public benefit,
   2.2) Translating ideas into projects, formulating strategic management plans, and defining success indicators,
   2.3) Conducting performance evaluations, and
   2.4) Continuously refining work plans (Mahaphon & Kanlayanamit, 2021).

Innovation in the public sector may involve revising or overhauling policies, organizational management processes, or the design and delivery of public services-even rethinking the status and role of the public sector in the economy and society, as well as exploring new modes of collaboration with other organizations. Building sustainable public sector innovation in administration starts with innovative leaders who set a clear vision and develop a prepared workforce. This process also involves fostering creativity to overcome obstacles, leading to the development of strategic projects with clear success metrics and evaluation for continuous improvement. Therefore, collaboration and cross-sector knowledge transfer are crucial for these processes to materialize effectively and tangibly.

The Development of Strategies and Policies to Support Innovation

1. Resource Management for Promoting Innovation

Effective resource management is key to fostering innovation and includes budgetary, human, technological, and infrastructural resources. Strategies for managing resources to support innovation can be summarized as follows:

1) Allocating Budgets for Sustainable Innovation: Budgets are crucial for continuous and efficient innovation projects. Governments should set aside dedicated funding for innovation, such as establishing a public innovation fund and promoting private sector investment. For Thailand, allocating budgets for sustainable innovation development must go beyond simply increasing funds. It should focus on smart and targeted investments, specifically in research and development (R&D) that directly addresses the country's urgent problems and needs, such as clean energy, healthcare, education, or smart agriculture. Simultaneously, transparent and auditable mechanisms must be established to ensure funds are utilized efficiently and generate maximum returns.

2) Developing Personnel to Support Innovation: Human resources play a crucial role in conceiving and developing innovations. Strengthening skills among public sector personnel-for example, through digital technology training, innovation management, and creative thinking-help them effectively apply new technologies and ideas to the organization. Developing personnel requires upskilling to keep pace with the future world through training programs aligned with new technologies, promoting lifelong learning, and

experience exchange across sectors. This will cultivate public sector personnel into capable innovators and researchers, becoming efficient government employees who can drive tangible and sustainable innovation.

2. Risk Management and Strategic Adaptation

Risk management in innovation involves assessing and responding to risks associated with creating or improving new services or internal processes. Common risk sources include rapidly advancing technology, shifting markets, operational errors, and changes in laws or regulations. Effective risk management includes identifying and assessing risks, devising response plans, and continually monitoring and evaluating outcomes.

A classic example is the use of risk management tools such as SWOT analysis (Strengths, Weaknesses, Opportunities, Threats) to help organizations identify internal and external factors that influence their innovation (Tushman & O'Reilly, 1996). Meanwhile, strategic adaptation refers to how organizations adjust to internal and external environmental changes to capitalize on new innovations. This might involve altering business models, adopting emerging technologies, or bolstering competitiveness (Hill & Jones, 2012). Organizations adept at adaptation are flexible, learn from failure, and continually refine their processes—for instance, by leveraging innovations that improve manufacturing or service efficiency and by implementing strategies that emphasize long-term customer satisfaction (Kaplan & Mikes, 2012). In a rapidly changing world, ignoring risk management and strategic adaptation is not an option. Introducing new innovations requires meticulous risk planning, while simultaneously adjusting organizational strategies to handle changes effectively, ensuring survival and growth in a challenging environment (Dess & Eisner, 2012).

Case Studies of Effective Innovation Management

1. E-Government in Estonia

Public sector innovation is a key strategy enabling governments to effectively meet citizens' needs. Estonia serves as a global model in integrating information technology into public sector administration, particularly through its e-Government system, which has made public service delivery faster and more transparent. Estonia's e-Government exemplifies how information technology can enhance government efficiency. The country initiated IT-driven public service reforms in the 1990s, recognizing the need to modernize and improve administrative processes. It then developed the necessary digital infrastructure to provide convenient services to citizens. One of Estonia's most successful digital initiatives is its e-ID system, which enables citizens to securely perform financial transactions and access a wide range of government services online. The country's integrated e-Government platform brings together essential services such as citizen registration, tax filing, job applications, and even online voting. This system enhances transparency in public service delivery and significantly lowers administrative costs. (OECD., 2020).

Success and Challenges: Estonia's e-Government success is not solely the result of IT investments, but also a clear policy framework supporting digital adoption in public administration and staff training in digital platforms. Nonetheless, challenges persist, particularly in maintaining data security and gaining public trust
in online services. Estonia's experience demonstrates that harnessing information technology to develop transparent, efficient public services can significantly reduce costs and better serve citizens. Technology thus plays a key role in enabling governments to provide modern, effective services. (OECD., 2020).

2. Adopting Artificial Intelligence (AI) in Singapore's Civil Service

Singapore began deploying AI in its public sector under the Smart Nation initiative in 2017. AI is now used for urban management and environmental monitoring. A prime example is the 'Ask Jamie' digital assistant-developed by GovTech-which leverages natural-language AI to answer public queries about government services. This system helps citizens quickly access accurate information, while also improving

administrative efficiency by reducing processing times and workloads. Consulting (2017) Singapore's AI implementation in the civil service underlines how technology can be employed to upgrade public services and decision-making processes. AI aids in swift, precise decision-making, thereby enhancing transparency and public confidence. While data security and privacy remain challenging, AI innovation in Singapore's public sector continues to play a crucial role in advancing the country.

3. Challenges in Managing Innovation within the Thai Public Sector

Rapid technological progress and the rise of innovation have diverse impacts, both positive and negative. On the positive side, innovation increases efficiency, reduces costs, and creates new economic opportunities. However, challenges include workforce displacement by automation and ethical issues such as breaches of data privacy in the digital age (Ford, 2015).

In Thailand, the government introduced applications like "Pao Tang" and "Mor Prom" to streamline financial assistance and public health services during the COVID-19 pandemic (Digital Government Development Agency, 2022). And the "Rao Mai Ting Kan" (We Will Not Leave Anyone Behind) project showcased the Thai government's effective use of digital innovation as a crucial tool for risk management and strategic adaptation during a crisis. By developing an online registration system and employing AI, the project enabled the rapid, accurate, and transparent verification of eligibility and disbursement of massive relief funds. This reduced errors and increased coverage, demonstrating a successful application of innovation to address immediate challenges and build public trust in government operations. Despite these initiatives, innovation management in the Thai public sector continues to face significant hurdles related to organizational culture, resource allocation, and structural limitations.

Structural Issues and Bureaucratic Systems Affecting Innovation Management

1. Resistance to Change and Participation

Innovation management in the public sector often encounters structural barriers and bureaucratic hurdles, hindering operational efficiency. One major obstacle is hierarchical governance, which slows decision-making. Consequently, any attempt to implement new ideas must navigate cumbersome regulations and procedures. Additionally, a conservative organizational culture can dampen motivation for innovative change among government personnel. Budgetary and procurement constraints also tend to prioritize stability and risk aversion over promoting innovation.

At the same time, although new technology and improved operational processes can boost efficiency, these innovations may face resistance from personnel unprepared to embrace changes. This resistance can stem from fear of job loss, discomfort in leaving behind familiar working methods, or a lack of confidence in handling new systems (Kotter, 1996). Resistance can manifest at the individual, agency, or even national level, undermining the successful adoption of new technology or procedures in public service provision. The centralized power structure and rigid hierarchical system within the Thai bureaucracy significantly hinder innovation and lead to a lack of flexibility. For policy recommendations, decentralizing decision-making to operational levels is crucial. Additionally, streamlining complex procedures and regulations will increase agility, while fostering an open organizational culture that embraces experimentation and tolerates failure will genuinely create an environment conducive to new innovations. These changes will ultimately enable the government to adapt and respond to challenges more effectively (Borins, 2014).

2. Pathways to Innovation Development in the Thai Public Sector

Thailand is an agriculturally based nation rich in natural resources. Consequently, local innovation is an important pathway for boosting production efficiency and enhancing the quality of life of farmers. By adding value to local raw materials-such as agricultural processing or organic agriculture that meets health market demands -producers can secure sustainability. Government and private sector support in providing technology funding, online marketing promotion, and the establishment of agricultural innovation centers

in each locality enables farmers to access crucial knowledge and tools, strengthening Thailand's agricultural sector on a sustainable basis.

With the aim of enhancing the country's economic potential, the Thai government has taken steps to help farmers break free from the "commodity trap" of selling low-priced agricultural products in highly competitive global markets. For example, the Department of Foreign Trade, Ministry of Commerce, established the Institute for the Promotion of Innovative Agricultural Products (SKN) on April 3, 2017, to study innovation market trends, support entrepreneurs in applying innovation to add value to their products, promote marketing efforts, and publicize these products. This work is overseen by a management committee in charge of promoting innovative agricultural products and driving Thailand's advanced processed agricultural innovations to the market (Office of the Prime Minister's Secretariat and colleagues, 2018).

Another initiative is the "Start Up & Innovation" credit guarantee program for new and innovative entrepreneurs, aiding SMEs with high potential in accessing funding from financial institutions. This boost helps SMEs enhance productivity, add value, stay competitive, and strengthen industrial sectors nationwide by bridging public and private networks to assist innovative and technology-oriented SMEs (Office of the Prime Minister's Secretariat and colleagues, 2018).

By applying innovation, whether from government programs or from local wisdom-across the entire production process (from planting and processing to marketing), the public sector can substantially assist farmers and grassroots communities, thereby stimulating local economies. Local wisdom and traditions can be modernized with electronic devices or technologies, making tasks easier, faster, and more productive. Officials can also help establish reliable sales outlets or create sustainable distribution channels. This approach represents "local innovation", which involves the formulation and implementation of new approaches for delivering public services. Not all local innovations require scientific or technological knowledge; rather, local innovation can arise from new, creative ways of thinking or viewing traditional practices in local governance or public service provision (Chamchong, 2018).

Local innovations bring together modern concepts, technology, and methods tailored to specific regional issues, and can originate in the public sector, private sector, or civil society. The main goal is to enhance the quality of life for residents, increase administrative efficiency, and promote sustainability. Examples include:

1) Handicrafts and Local Food: The innovative production methods of silk-weaving groups in Surin province or the Surin-based community enterprise producing silver and brass jewelry in Ban Natang, Khwao Sinarin Subdistrict (Laothong, 2021). Another example is the Ban Khok Wan rice flake processing group (Khao Mao) in Nong Son Subdistrict, Nang Rong District, Buriram Province, which revitalized Khao Mao with innovative techniques to diversify traditional products.

2) Technology-Assisted Local Innovations:

2.1) Emergency Reporting and Complaint Applications (e-Service)

Many local administrative organizations (LAOs) have developed apps for real-time reporting of municipal issues-such as damaged roads or water and power outages. Examples include "Traffy Fondue," used by Bangkok Metropolitan Administration and other municipalities.

2.2) Smart Municipality

Integrating digital technologies in municipal Management-for instance, using the Internet of Things (IoT) to monitor water levels and prevent flooding or employing AI to analyze waste volumes. Chiang Mai Municipality installed air-quality sensors to reduce smog problems.

2.3) Innovative Waste Management

Encouraging citizens to separate waste by implementing a point-based reward system. "Klaibaan App" in Phuket, for instance, allows residents to trade recyclable waste for digital-based compensation.

In 2021, the Digital Government Development Agency launched the "Local Digital Innovation" competition for the first time, inviting local administrative organizations to showcase their digital solutions

for public service as a move toward digital government. Three winning projects included: (1) Saen Suk Town Municipality's program for smart healthcare services for the elderly, (2) Pang Mu Subdistrict Administrative Organization in Mae Hong Son Province's "Pang Mu E-Smart Service," and (3) Yala City Municipality's system to monitor and manage the COVID-19 pandemic (Ananttanathorn, 2023).

In essence, local innovation involves the creation and utilization of novel methods, technologies, or approaches that address specific needs and challenges within a community, relying on local resources, culture, and wisdom. Examples include employing smart farming technologies to boost agricultural productivity, developing online marketing platforms to reach global markets, harnessing clean energy sources within communities, and deploying digital systems in local government for more efficient public services. Effective local innovation ensures sustainable development and resilience of communities. The success of innovation can be measured by increased productivity and income for the populace, coupled with an elevated quality of life, encompassing aspects like happiness, convenience, and safety in daily living.

Creating an Innovation Culture

1. Components of an Innovation Culture

In an era of rapid technological change and intense business competition, a "culture of innovation" has become a crucial factor in organizational growth and effective adaptation. Such a culture involves an internal environment that encourages creativity, knowledge sharing, and the willingness to implement new ideas, which in turn drives sustainable development. Key components of an innovation culture include:

1) Innovation-Supporting Leadership: Leaders play a pivotal role in shaping direction and fostering an environment in which employees feel safe to propose and experiment with new ideas, including learning from failure (Amabile & Pratt, 2016).

2) Organizational Support: Organizations must have structures and policies that nurture innovation, such as adequate resource provision, dedicated innovation units, and channels for employees to submit new ideas (Drucker, 2014).

3) Continuous Learning and Development: An innovative culture relies on learning from experience, coupled with ongoing skill development. It is crucial to encourage experimentation and to apply lessons learned in practice (Nonaka & Takeuchi, 1995).

4) Employee Participation: Innovation thrives when personnel at all levels can voice their opinions and participate in shaping new initiatives. Organizations should involve employees in decision-making and in developing new projects (Kim & Mauborgne, 2017).

Building such a culture often calls for investment in both technology and human resources. Technology enhances work efficiency, while human resource development strengthens creativity and adaptability. Additionally, public and private sector engagement plays a vital part in driving innovation. Citizen participation reflects societal needs, while private sector investment and expertise form an ecosystem that sustains innovation. Establishing an innovation-oriented organization entails promoting fresh ideas, providing a supportive environment for trial and error, and motivating staff to create novel approaches-allowing the organization to evolve and remain competitive.

2. Investing in Technology and Human Resources

Investing in technology and human resources drives an innovative culture. As technology and business environments change rapidly, organizations seeking competitiveness and sustainability must foster an "innovation culture" as the bedrock for continuous development. Two elements are central to this culture: technology and human resources, which, when integrated, can fuel new ideas and effective adaptation.

1) Technology as a Driver of Innovation

Technology significantly enhances the creation and development of innovations. Organizations that invest in cutting-edge technologies-such as AI, big data analytics, and automation-often streamline operations and rapidly incorporate new ideas (Tidd & Bessant, 2020). Technology also fosters greater flexibility, promotes

collaboration through digital platforms, and reduces communication barriers, forming a key pillar in the pursuit of innovation (Christensen, 2013).

2) Human Resources as the Heart of Innovation

Despite the power of technology, human resources remain essential to sustaining an innovative culture. Organizations that prioritize employee development encourage creativity and effective problem-solving. Training in areas such as design thinking and innovation management equips employees to harness technology and knowledge more successfully (Nonaka & Takeuchi, 1995). Establishing a collaborative environment where employees can share ideas, experiment, and learn-boosts motivation and ownership of innovation processes (Amabile, 1996). In summary, cultivating an innovative culture is vital for competitiveness and sustainability. Investment in technology enhances operational efficiency, while investment in human resources bolsters creativity and problem-solving capabilities. When both are well-integrated, organizations can effectively drive innovation and achieve long-term growth.

3. Participation from the Public and Private Sectors

An innovative culture is a key factor in economic and social advancement, and broad-based involvement-across government, private enterprise, and the general public-is crucial for its success. This collaboration underpins an innovative ecosystem that supports both local and nationwide transformation and progress. The roles of the public and private sectors are as follows:

1) The Public's Role in Building an Innovation Culture

Members of the public are directly affected by innovation and can serve as a source of new ideas. Through engagement in policymaking and project development, citizens help shape innovations that align with societal needs (Von Hippel, 2005). Public participation takes various forms, such as co-creation, where citizens work with organizations to design services suited to real-world requirements. Digital platforms facilitating idea-sharing and collaboration also spur "user innovation," which can influence broad economic development (Chesbrough, 2019).

2) The Private Sector's Role in Fostering an Innovation Culture

Private firms often adopt open innovation strategies that encourage knowledge exchange among government, citizens, and academia, fueling more efficient technological and innovative breakthroughs (Chesbrough, 2003). The private sector also invests in R&D, enabling experimentation with novel technologies that may be commercialized. Major tech companies like Google, Microsoft, and Tesla fund startups and research institutes, thus reinforcing the broader innovation ecosystem. Additionally, the private sector can nurture an innovative culture by creating environments conducive to creative problem-solving-often through Corporate Innovation Labs, which serve as hubs for experimenting with new ideas to address business and societal challenges (Tidd & Bessant, 2020).

3) Collaboration between the Public and Private Sectors in Innovation Development

Public–private cooperation is vital for building a robust innovation culture. A successful example is the Smart City initiative, which integrates technology and urban development via citizen feedback and private-sector investment to create intelligent and sustainable infrastructure (Glaeser & Cutler, 2021). Another approach, Public–Private Partnership (PPP), helps both sectors collaborate on innovation projects that can be scaled to the national level. Notables are joint renewable energy and digital technology projects carried out by government, private sector, and local communities (Mazzucato, 2018). The creation of an innovative culture requires the concerted efforts of all stakeholders, particularly citizens and private enterprises. While citizens propose ideas and ensure innovation addresses real needs, the private sector provides resources, technology, and investments to accelerate development. When both sectors collaborate in initiatives like Smart Cities or PPPs, they can forge a robust innovation ecosystem, paving the way for sustainable, long-term development.

4. Innovative Organizations

An innovative organization refers to one that can conceive, develop, and integrate new ideas to enhance efficiency and create value by fostering a culture supportive of creativity and change. Such organizations

emphasize learning and adaptation to remain competitive and viable in volatile environments. Key attributes include:

1) Innovation Culture: Encourages employees to propose and execute new ideas,

2) Flexible Management: Capable of adjusting swiftly to changes,

3) Leadership Support: Leadership that allows for experimentation, and

4) Investment in Human Resources and Technology: For ongoing growth (Tidd & Bessant, 2020). Examples of innovative organizations (Mimak, 2023) include:

1) Ideation Innovation (e.g., Gillette's razor and blade strategy, selling the main handle cheaply and profiting from the consumable blades),

2) Process Innovation (e.g., IKEA's concept of flat-packed furniture for easy self-assembly),

3) Product Innovation (e.g., Microsoft bundling separate programs into Microsoft Office suite),

4) Marketing Innovation (e.g., Nespresso's multi-channel distribution through retail stores, online, partnerships with hotels, and airlines),

5) Service Innovation (e.g., 7-Eleven's comprehensive services, including bill payments),

6) Cost Innovation (e.g., the low-cost airline model that optimizes cost structures). Technological advances drive innovation across diverse industries, making life easier and higher quality. Although innovation poses certain challenges, proper management ensures technology can underpin sustainable development that benefits society broadly.

Innovation within public sector organizations encompasses various dimensions:

1) Public Service Innovation: This includes digital government services (e-Services) like online tax filing and online business registration. 2) Work Process Innovation: Examples include paperless systems and enhanced inter-agency collaboration. 3) Organizational Structure and Management Innovation: This involves establishing government innovation labs and fostering an organizational culture that is open to and supports innovation. 4) Public Policy Innovation: This dimension features creative problem-solving policies and the use of technology for policy monitoring and evaluation. Notable examples of public sector innovations in Thailand include the "Rao Mai Ting Kan" (We Will Not Leave Anyone Behind) project, the "Pao Tang" application, the "Traffy Fondue" repair notification system, electronic permit applications (e-Permit), and government services provided via the ThaiID application.

Policy Recommendations on Innovation for Sustainability in the Public Sector

Policy recommendations for sustainable public sector innovation include the following:

1. Invest in Innovation Infrastructure: Governments should support the technology and data infrastructure essential for innovation (e.g., R&D centers, open data platforms, and digital networks) to drive modern advancements.

2. Promote Sustainable Research and Development (R&D): Funding projects focused on clean energy, green technology, and circular economy solutions can mitigate environmental impact and foster sustainable growth (UNCTAD, 2019).

3. Develop Human Resources for Innovation: Governments should provide education and training to equip workers with necessary digital skills-such as AI, data analytics, and blockchain (World Economic Forum, 2020).

4. Introduce Innovation-Friendly Legislation and Incentives: Implement tax incentives for environmentally friendly innovations and enact laws supporting safe, ethical use of digital technologies

5. Public–Private Collaboration (PPP) in Innovation: Partnerships between the public and private sectors enable knowledge and resource sharing, resulting in practical, scalable innovation projects that benefit society (Mazzucato, 2018).

Based on the outlined policies, the Thai government's top priority should be human resource development in innovation. This is because skilled and knowledgeable personnel are the most crucial foundation for driving innovation across all sectors. Talent is Key: Investing in education and training to equip the workforce with essential digital technology skills-such as AI, data analytics, and blockchain-will create " high-quality innovation workers " capable of genuinely creating, utilizing, and expanding innovation (World Economic Forum, 2020) Quality personnel will ensure optimal returns from infrastructure investments, enable efficient research and development, and drive the creation and application of innovation-incentivizing policies and laws. This also fosters long-term sustainability as investing in people yields lasting returns, with knowledge and skills remaining and evolving, once a highly capable and ready workforce is established, investments in infrastructure, R&D promotion, new legislation, and public-private partnerships can proceed more effectively, yielding tangible and sustainable results.

Body of Knowledge

From Figure 1, Local Innovations involve applying new concepts, knowledge, technologies, or methods to create novel solutions. These innovations can leverage technological and scientific knowledge, such as using solar power for agricultural irrigation systems by adapting solar cell technology to reduce energy costs. Other examples include using AI to assist in fabric pattern design or villagers utilizing machinery to speed up weaving. Conversely, some local innovations do not rely on technological and scientific knowledge. Examples include traditional irrigation management systems like "Muang Fai" (weir systems), or designing local handicraft products from natural materials, such as basketry and traditional weaving that emphasize original patterns and techniques. In reality, the distinction between these two types of innovation can be somewhat blurred. Some non-technological innovations may inherently contain "folk science," such as simple physics principles in tool-making or basic chemistry in food preservation. Similarly, technology-based innovations often require an understanding of local context and traditional wisdom to be truly beneficial and sustainable within the community. They could either be newly created since such innovations or devices had never existed before or developed as an extension of the existing knowledge base within the community or locality. The key is to build upon what already exists, enhancing it into a more efficient, convenient, and modern innovation. Local innovations are beneficial in increasing work efficiency, reducing time spent on tasks, improving the quality of life for community members, and fostering local sustainability. This is because they can be specifically adapted to address localized problems. For example, innovations can be applied to agricultural practices, such as processing agricultural products into community goods for sale. They can also be integrated into local craftsmanship rooted in traditional wisdom, such as weaving, basketry, and other handicrafts. Moreover, innovations may be used to develop other areas or help solve various community issues, aiming to create livable, safe communities where people enjoy an improved quality of life.

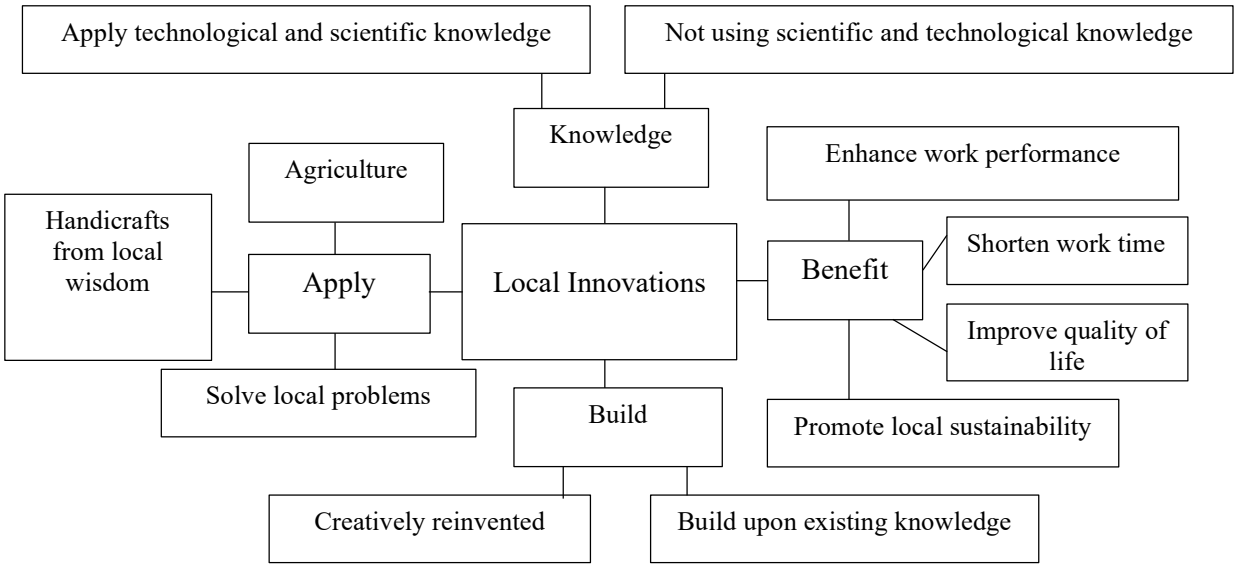

Figure 1. Guidelines for Innovation Development in the Thai Public Sector: Local Innovation

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