A Framework to Identify Factors Affecting SMR Acceptance in Thailand

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EXTENDED ABSTRACT

In an era marked by the global energy crisis, climate change, and mounting pressure to reduce carbon emissions, Small Modular Nuclear Reactors (SMRs) have gained increasing attention as a stable, flexible, and low-carbon energy alternative. These advancements highlight the potential of SMRs for application in Thailand, both in electricity generation and industrial cogeneration, such as in oil refineries, petrochemical plants, seawater desalination, and clean hydrogen production. Thus, SMRs present a promising option for Thailand's energy future.

At the policy level, Thailand's 2024 Power Development Plan identifies SMRs as a future energy source of national importance. However, nuclear technology is often perceived as riskier than its actual risk, especially after the Fukushima event. Hence, this study proposed a framework to identify factors affecting the acceptance of SMRs in Thailand, drawing upon established theoretical models of technology acceptance and public perception, including insights from previous research on nuclear technology acceptance in Thailand (Tantitaechochart et al., 2020), as shown in Figure 1. In this figure, we hypothesized that risk and benefit perceptions and trust were influenced by information perception. Information perception was hypothesized to be influenced by socioeconomic status. Finally, the SMR acceptance was hypothesized to be influenced by risk attitude, trust, information perception, and socio-economic status.

The proposed framework is grounded in well-established theories. The extended Technology Acceptance Model (TAM) provides a basis for understanding how individual beliefs, such as perceived trust and perceived information quality, influence the intention to adopt new technologies. In this context, technology acceptance is conceptualized as a multidimensional outcome influenced by cognitive, affective, and informational factors, rather than solely by perceived usefulness and ease of use. The concept of risk-benefit perception suggests that individuals often evaluate technologies through an intuitive, affect-driven process, in which higher perceived benefits tend to reduce perceived risks, and vice versa. This inverse relationship reflects the influence of emotional responses known as the affect heuristic on how people interpret the desirability and safety of unfamiliar technologies. Social trust theory emphasizes the importance of public confidence in institutions and stakeholders responsible for developing or regulating technologies. When these entities are perceived as transparent, benevolent, and competent, trust increases, thereby reducing perceived risk and enhancing perceived benefits. These perceptions are further shaped by the quality and clarity of information individuals receive, aligning with risk communication theory, which posits that accessible and credible information fosters informed evaluations. Socioeconomic status (SES) is integrated as a background factor influencing how individuals access, process, and interpret such information. This perspective draws conceptually from the knowledge gap hypothesis, information-processing capacity theory, and broader insights from social stratification research, which collectively suggest that individuals with higher socioeconomic status (SES) often possess greater informational access and cognitive resources, thereby shaping their trust, perceptions, and ultimately, their acceptance of new technologies. Structural Equation Modeling (SEM) is employed to test these theoretical relationships and quantify their influence on SMR acceptance, as illustrated in Figure 1

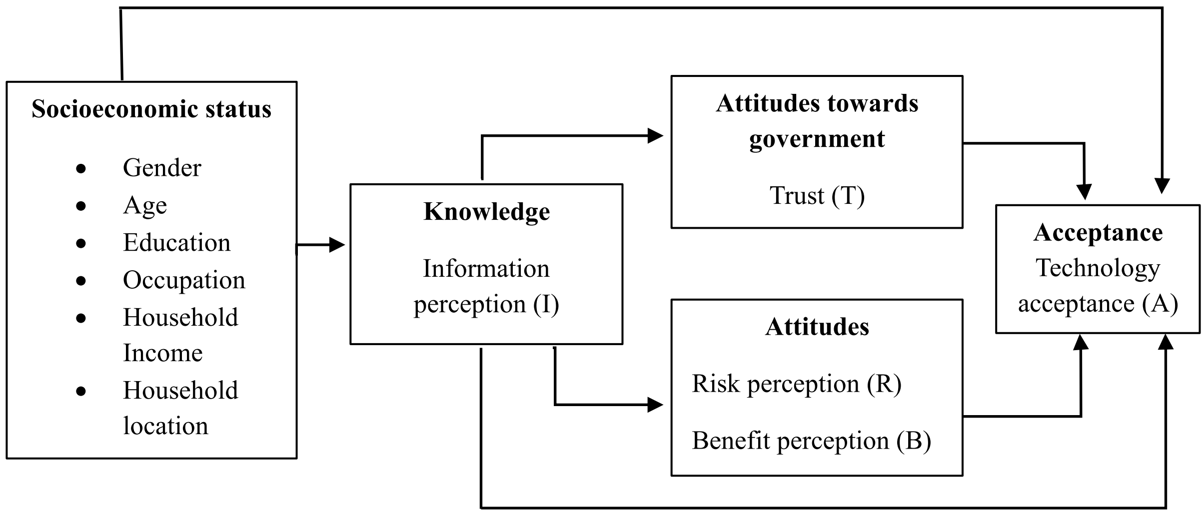

Figure 1: The framework to measure public perceptions toward SMR acceptance in Thailand

A questionnaire carefully designed to contain potential exogenous variables in the SEM model in Figure 1 is presented below. This questionnaire was developed based on established literature and theory, with its questions specifically formulated to operationalize the constructs and gather data for empirically testing the hypothesized relationships within the framework.

Information perception (I):

I1: I receive sufficient and continuous information about Small Modular Reactor (SMR) power plants.
I2: I have a basic understanding of how Small Modular Reactor (SMR) power plants operate.
I3: Small modular reactors (SMR) power plants use less fuel than fossil fuel power plants.
I4: Small modular reactors (SMR) power plants require cooling towers to dissipate heat.

Trust (T):

T1: If a Small Modular Reactor (SMR) power plant is constructed, the public will have access to information about it.
T2: The government will implement strict and thorough security policies for SMR power plants.
T3: In the event of an accident at an SMR power plant, the government is well-equipped to manage the emergency.
T4: Thailand has knowledgeable and capable personnel necessary to ensure the safety of SMR power plants, which meet international standards.
T5: Thailand has the knowledgeable and capable personnel necessary to manage radioactive waste from SMR power plants following international standards.

Risk perception (R):

R1: The risk of an accident at an SMR power plant is higher than that of a traffic accident.
R2: An accident at an SMR power plant could have impacts comparable to a large nuclear power plant.
R3: The prospect of living near an SMR power plant is frightening.
R4: I have extreme concern about the potential impact of radiation from radioactive waste on my family if our home were near an SMR power plant.

Benefit perception (B)

B1: Constructing an SMR power plant can create jobs for the communities around the site, which is a significant economic development opportunity.
B2: I would be willing to have an SMR power plant in my community if the residents received appropriate compensation.
B3: SMR power plants could lower electricity prices in Thailand.

B4: SMR power plants are crucial to ensuring the nation's energy security.
B5: Nuclear energy can help reduce greenhouse gas emissions, essential for transitioning to a low-carbon society.

Technology acceptance (A):

A1: I support the construction of an SMR power plant in my community.
A2: I support the construction of an SMR power plant in my province.
A3: I support the construction of an SMR power plant in Thailand.
A4: Thailand should increase the number of SMR power plants instead of relying on fossil fuels.

We developed this framework to measure SMR acceptance, with the questionnaire designed based on established literature and theory. Our data collection aimed to capture responses from diverse citizens across different socioeconomic backgrounds to reflect varied perspectives. Structural Equation Modeling (SEM) was then employed to validate the model and identify significant predictors of public acceptance. The findings are expected to provide actionable insights for policymakers and stakeholders to enhance public engagement and foster informed decision-making in the implementation of SMR technologies.

Keywords: Small Modular Nuclear Reactors (SMRs), Questionnaire, Public Perception, Risk Communication, Structural Equation Modeling (SEM), Technology Acceptance