RESEARCH ARTICLE

Innovative Health Mattress Acceptance: Using Technology Acceptance Model

Suchana Kunuratna[1], Sani Boonyagul[2], Nuntachai Thongpance[3], Chairat Mekkaew[4], Phichitphon Chotikunnan[5], Anantasak Wongkamhang[6]*

[1,2,3,5,6] College of Biomedical Engineering, Rangsit University, Pathum Thani, Thailand.
[4] College of Engineering, Rangsit University, Pathum Thani, Thailand

ARTICLE INFO	ABSTRACT
    *Corresponding Author: anantasak.w@rsu.ac.th	Health Mattress is a sleep platform designed to provide users with comfort, promote user health and sleep quality. The health mattress market has shown continuous growth trends due to various supporting factors; this has led to many players in the market, both domestically and internationally. While there are many types of available health mattresses, there is still a lack of data to accurately define the market conditions for this product group. Additionally, there is insufficient information to confidently determine whether manufacturers truly understand consumer needs adequately. So, this research studies factors that influence acceptance of health mattress usage by the structure of Technology Acceptance Model (TAM) Mattress Properties and Sleep Quality, considering external factors such as mattress property, health condition, sleep quality, and price. Then, the Structural Equation Modeling (SEM) will be analyzed to examine the relationship of factors leading to the acceptance of technology, with a sample size of 300 participants in Thailand. The result shows that all variables are significant influence towards the behavioral intention to use of health mattress. These data are essential for manufacturers and related businesses to create opportunities for designing and developing health mattress products to engage consumer prospects. Additionally, consumers can use this data for a decision making and selecting a suitable health mattress that meet their health needs.

INTRODUCTION

Globalization shows a rapid transformation of society, economy, politics, environment, technology, and even new regulations in global trade, natural disasters, or even pandemics (Ayaz, 2021). It poses challenges for businesses in many sectors that must adapt to the repercussions of these changes. Conversely, businesses related to the health trend seem to have less affects and show a continuous upward trend (Yeganeh, 2019). There is a tendency for health-related businesses to grow up, driven by changes in consumer behavior and daily lifestyles. Current consumers are increasingly health-conscious, emphasizing the importance of adopting healthy lifestyles and choosing products that promote health in various aspects (Pu et al., 2020), including high-quality, standard, and safe products which are available in the market. According to these consumer behaviors require businesses to adjust with the rising competition. Therefore, businesses gain a competitive edge so they must create differentiation and uniqueness in their products (Dirisu, Iyiola, & Ibidunni, 2013), aligning with the changing technology and consumer behaviors by leveraging technology and innovation to foster creativity and add value to products to meet customer needs (Nguyen & Kira,

2001). This, in turn, helps businesses not only meet consumer requirement but also establish a competitive advantage in the market.

Health related products, particularly in the category of sleep-related products are another group worth keep an eye on, especially in mattress products. The mattress market has shown continuous and rapid growth over the past few years (Grand View Research, 2020), there has been a shift in customer purchasing behavior, emphasizing health care and an increasingly high-quality lifestyle, especially among people who prioritize health-conscious living and sleep quality products suitable to their specific needs and health concerns and the expansion of the real estate and hotel resort businesses (Insights, 2022). The mattress market in Thailand is now highly competitive (Research, 2023), with numerous manufacturers and distributors both domestically and internationally shared in the market. Nowadays, there is a focus on designing health-conscious mattresses that cater to the diverse needs of consumers, promoting physical recovery and injury prevention (Caggiari et al., 2021), with these situations, the existing and new market entrants of health mattress businesses need the innovation and research and development continuously to offer innovative and consumer driven health mattress products.

In the category of mattresses that has the rapid growth is the segment of health mattresses or those designed with technology and innovation (Grand View Research, 2020) to promote user health based on usage behavior, with the possess features aimed at addressing sleep related issues, enabling users to sleep comfortably without experiencing discomfort or stiffness and adequately support body weight (Jacobson et al., 2008). Furthermore, health mattresses need to have good air circulation, odorless, and durable. The importance of quality sleep is underscored by its vital role in bodily and mental functions. During sleep, the brain organizes various information, contributing to memory formation and sequential development and preparing individuals for subsequent activities or life endeavors. (Ramar et al., 2021). Insufficient sleep can adversely impact various body systems (Owens et al., 2014), affecting emotions with potentially leading to have more stress while decreasing immune system so increasing susceptibility to various diseases. Although there are various health mattress types in the market but there is still a lack of comprehensive market related scientific data for this product category. This includes information that can delineate market conditions and instill confidence that manufacturers sufficiently understand consumer requirement to deliver appropriate innovative and technological mattress products. So, this research will studies factors that influence acceptance or decision making to use new technology or innovation by the structure of Technology Acceptance Model (TAM) which are widely used in many studies especially in healthcare technologies (AlQudah, Al-Emran, & Shaalan, 2021; Harris & Rogers, 2023; Nguyen et al., 2020). These factors are a key factor directly influencing users' acceptance of technology, considering external factors such as Mattress Property, Health Condition, Sleep Quality, and Price, which are influenced by perceptions that vary among individuals. The influence of these factors will affect Perceived Usefulness and Perceived Ease of Use, which in turn influences Attitude toward using and ultimately leads to Behavioral Intention to use the technology or innovation. Then, the Structural Equation Modeling (SEM) will be analyzed to examine the relationship of factors leading to the acceptance of technology (Hair Jr et al., 2021). Therefore, this study research will derive the information that can open opportunities for the development of sleep technology that aligns with health promotion and physical recovery, benefiting businesses associated with health mattresses and related sectors in the future.

2. LITERATURE REVIEWS AND THEORETICAL BACKGROUNDS

2.1. Health Mattress

Mattress is a material that supports the body's contours during sleep, allowing the body to rest and recover various functions which can be placed on a bed or directly on the floor. Typically, the main materials used in mattresses include memory foam, water foam, coconut fiber, springs, latex

Generally, there are 3 standard sizes: 3.5 feet, 5 feet, and 6 feet, respectively. There are various types of mattresses available based on the characteristics of the materials or usage patterns, and efforts have been made to increase diversity. Health mattresses are widely discussed nowadays and come in various forms in the market. They are designed to provide users with comfort and promote user health, whether a dust mite-resistant mattress, alleviates body aches, helps reduce snoring, improves sleep efficiency, or accommodates different sleeping positions (Shen et al., 2012). Now they are often incorporate additional features through the application of technology and innovation to promote user health (Caggiari et al., 2021), mainly aimed at alleviating various sleep related issues. These issues may involve different parts of the body prone to discomfort, such as knees, backbone, shoulders, neck, or even various joints like ankles or knees, caused by improper sleeping posture (Myers et al., 2015) The design and development of health mattresses should consider users' needs and mattress characteristics to ensure users' benefits, convenience, and safety. Generally, health mattresses available in the market focus on addressing sleep related problems, allowing users to sleep comfortably, providing body support at various points, preventing injuries or discomfort while sleeping, and adequately supporting body weight (Priya, 2022) (Radwan et al., 2015).

2.1.2 Sleep quality and related factors

Sleeping is a fundamental activity essential to life. Humans spend more than one-third of their lives sleeping. During sleep, the body undergoes crucial mechanisms to prepare itself optimally for waking hours. Sleep stages comprise 2 main phases (Blumberg et al., 2020) which are 1. Non-Rapid Eye Movement Sleep (Non-REM Sleep): Stage 1: this is the onset of drowsiness, a short period where sleep begins. The brain activity slows down, and waking up during this stage may not result in feeling unrested, sometimes may have slow eye movements. Sleep in this stage doesn't significantly affect the body. Stage 2 (Light Sleep): this is the transition period from wakefulness to deep sleep. During this stage, the heart rate starts to slow down and the body temperature decreases slightly. This stage constitutes more than 50% of sleep time and impacts short term memory consolidation and increased focus. Stage 3 (Deep Sleep): also known as slow wave sleep, during this stage, the body becomes less responsive to external stimuli, if awakened during this stage will feel groggy. The body is at its most restful state, and growth hormone is released. 2. Rapid Eye Movement Sleep (REM Sleep or Dream Sleep): During REM sleep, rapid eye movements occur, and brain activity is similar to wakefulness. This is the stage where dreaming occurs most frequently. REM sleep is crucial for long-term memory consolidation, learning, and creativity. The sleep cycle typically starts with Non-REM stages before transitioning to REM sleep. The sleep cycle lasts approximately 90 minutes per round, with Non-REM stages taking up about 80 minutes and REM stage about 10 minutes (Blumberg et al., 2020) Ideally, a night's sleep should consist of 3 to 6 cycles for it to be considered restful and effective. Sleeping is the ultimate form of rest for the body (Krystal & Edinger, 2008). However, some people may experience sleep related problems due to insomnia or severe snoring, resulting in inadequate rest. Part of health problems and diseases may stem from insufficient or poor quality sleep, such as insomnia, sleep apnea, or shallow sleep (Clement-Carbonell et al., 2021) (Ramar et al., 2021) Factors related to sleep are physical factors including illnesses, fatigue and discomfort, psychological factors and emotions that disrupt sleep, diet, medication, and chemicals the body receives or other factors such as daily activities, environmental conditions like atmosphere, air quality, odors, light, color, sound, temperature, or sleeping accessories like beds, pillows, blankets, etc. (Chaput & Dutil, 2016) Therefore, it's evident that the mattress is one of the crucial factors influencing sleep health.

2.2. Technology Adoption

2.2 .1 TAM

The Technology Acceptance Model (TAM) was developed from the Theory of Reasoned Action (TRA) by Fred Davis (1989) (Davis, 1993) It utilized to study acceptance of technology without considering surrounding individual norms, focusing on various factors that influence acceptance or decision

making to adopt new technology or innovation, particularly those directly impacting user acceptance (Taherdoost, 2018). This is examined through external factors, influenced by perceptions that differ among individuals which can include factors such as knowledge, expertise, social behaviors, or experiences. These factors affect perceptions in two aspects: Perceived Usefulness and Perceived Ease of Use, which, in turn, influence Attitude toward using and eventually Behavioral Intention to use the technology or innovation immediately. However, sometimes users may perceive the usefulness and intend to use the technology or innovation without any accompanying attitude toward usage, hence there is a direct path from perceived usefulness to behavioral intention, influencing actual usage behavior in the end. TAM is the most famous model in understanding the users' acceptance of technologies and used widely in may studies including context of IT related and work related technologies (Davis, 1989) as well as technologies in healthcare system such as telemonitoring, E- health (AlQudah, Al-Emran, & Shaalan, 2021) to assess and evaluate the correlations between users and decision makers.
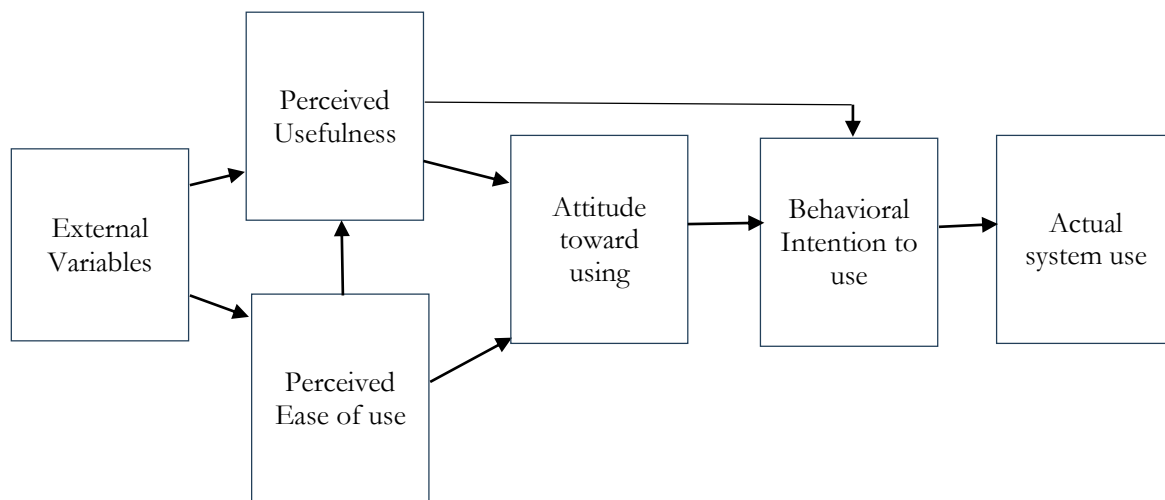
Fig. 1 TAM model

Table 1. Summary of related variables under the scope of this study

Group	Title	Method	Application	Input					Process		Output
		SEM	Mattress	Health Condition	Sleep Quality	Price	Mattress Property	Perceived Ease of Use	Perceived Usefulness	Behavior Intention
Technology Acceptance	The effect of perceived usefulness, perceived ease of use and perceived price on customer loyalty in GOJEK through customer satisfaction (study on GOJEK apps users in Jabodetabek) (2022)	✓				✓		✓	✓	✓
	Developing a Healthcare			✓				✓	✓	✓

Group	Title	Method	Application	Input					Process		Output
		SEM	Mattress	Health Condition	Sleep Quality	Price	Mattress Property	Perceived Ease of Use	Perceived Usefulness	Behavior Intention
	Technology Acceptance Model (H-TAM) for Older Adults with Hypertension (2021)									
	Customers' adoption of financial services offered by banks and FinTech's partnerships: evidence of a transitional economy (2021)	✓						✓	✓	✓
	Technology Acceptance in Healthcare: A Systematic Review (2021)			✓				✓	✓	✓
	Factors influencing the adoption of mHealth services in a developing country: A patient-centric study (2020)	✓		✓		✓		✓	✓	✓
	Using the technology acceptance model to explore health provider and administrator perceptions of the usefulness and ease of using technology in palliative care (2020)			✓				✓	✓	✓
	Validating the General Extended Technology Acceptance Model for E-Learning: Evidence from an Online English as a Foreign Language Course Amid COVID-19 (2019)	✓						✓	✓	✓
Heath Mattress	Beyond Sleep: Investigating User Needs in Today's Bedrooms (2024)		✓	✓	✓		✓			✓
	Sleeping for One Week on a Temperature-Controlled Mattress			✓	✓		✓			

| Group	Title	Method	Application	Input				Process		Output
		SEM	Mattress	Health Condition	Sleep Quality	Price	Mattress Property	Perceived Ease of Use	Perceived Usefulness	Behavior Intention
	Cover Improves Sleep and Cardiovascular Recovery (2024)									
	Computational Biomechanics of Sleep: A Systematic Mapping Review (2023)			✓	✓		✓			
	Investigating the influence of an adjustable zoned air mattress on sleep: a multi night polysomnography study (2023)			✓	✓		✓			✓
	Durability of a Soya-Derived Flexible PU Foam for Mattresses: Effects of Different Artificial Aging (2022)				✓		✓			✓
	Effect of using a home-bed mattress on bystander chest compression during out-of-hospital cardiac arrest (2021)			✓	✓		✓			✓
Proposed	A New Acceptance Model for Health Mattresses	✓	✓	✓	✓	✓	✓	✓	✓	✓

3. Research model and hypotheses
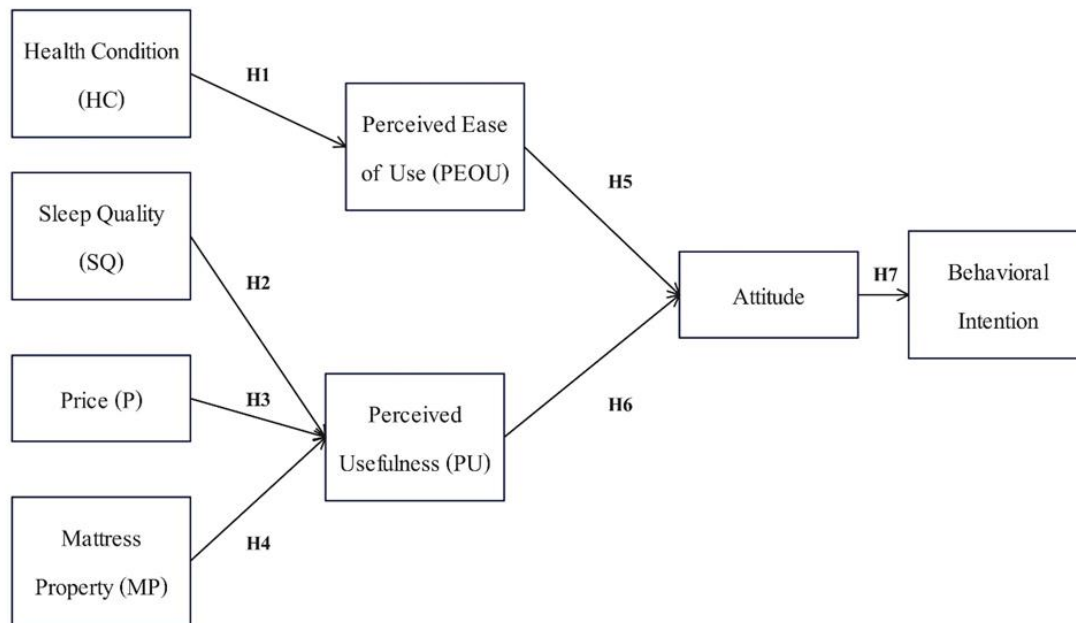
Fig. 2 Proposed model

3.1 Formulated model

The World Health Organization defines health as a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity, health conditions, like illnesses, injuries and impairments, affect our ability to function or enjoy life (Organization, 1995). Various health or medical conditions can significantly impact sleep quality such as chronic pain, arthritis, sleep apnea, and mental health disorders like anxiety and depression can disrupt sleep patterns and lead to insomnia or fragmented sleep (Health, 2018). Conversely, sleep quality can also impact health conditions, poor sleep quality and insufficient sleep duration have been linked to a range of health issues (Clement-Carbonell et al., 2021). The choice of mattress plays a vital role in sleep quality and overall comfort (Caggiari et al., 2021), when choosing a mattress, individuals with specific health conditions should consider their unique needs and preferences. Several studies have found that individuals with health conditions perceive health related technologies as easier to use compared to those without such conditions (Zhang et al., 2017). But on the other hand, individuals will be seeking to prevent serious health issues or maintain their well-being perceive health tracking wearables as user friendly tools for promoting proactive health behaviors (Pawlan, 2024) (Nuntaphon Chankong, 2023).

H1: Health Condition (HC) has a positive effect on Perceived Ease of Use (PEOU)

Sleep quality plays a vital role in overall well-being and good health (Clement-Carbonell et al., 2021). People spend more than one-third of their lives sleeping in bed. The mattress directly influences the quality of sleep experienced by an individual. There is a difference of sleep quality between sleeping on comfortable mattresses and uncomfortable mattresses, the comfortable mattress provides enough support for the body in getting to deep sleep and made more body movements so it can facilitate higher sleep quality (Lee & Park, 2006). A suitable mattress can provide proper support and comfort, which are essential for promoting restful and uninterrupted sleep (Caggiari et al., 2021).

Meanwhile, nowadays there are more technology options for tracking sleep; duration and quality of sleep, for example, wearable sleep trackers, such as watches, rings, and bands (Liu, Ploderer, & Hoang, 2015). If an individual perceives that using a sleep tracking device can help them identify factors affecting their sleep and make informed adjustments to improve sleep quality (Liu, Ploderer, & Hoang, 2015), they are likely to perceive it as useful tools for improving sleep quality, leading to increased acceptance and usage (Maher et al., 2017).

H2: Sleep Quality (SQ) has a positive effect on Perceived Usefulness (PU)

Price refers to the perceived cost associated with adopting and using a particular technology, which is not only the actual financial expenditure required to acquire the technology but also the perceived value users assign to the product or service in relation to its cost (Kortge & Okonkwo, 1993). Price influences user perception of the benefit of technology, thereby impacting their intention to use it. So, price is considered as one of the external variables that may affect user attitudes and behavioral intentions toward technology adoption at last (Suryatenggara & Dahlan, 2022). From the previous studies, lower prices and discount offer positively impact user perception of usefulness, leading to increased acceptance of technologies (Youn & Lee, 2019), (Sumi & Ahmed, 2022).

H3: Price (P) has a positive effect on Perceived Usefulness (PU)

Mattress is the sleep platform use for supports the body's contours during sleep (Shen et al., 2012). Mattress can be made from a variety of materials including memory foam, water foam, coconut fiber, springs, latex or hybrid. Selecting a mattress involves considering various properties such as firmness, material, breathability, durability, and motion isolation (Noyed, 2023). Mattress properties directly impact an individual's sleep experience, which, in turn, affects overall health and well-being (Jacobson et al., 2008), (Low et al., 2017), the demand of the mechanical properties of mattresses should be different to the people with different preferences in sleep posture (Chen et al., 2013). Few studies shows that people finding mattress in term of mattress engineered to support the body natural alignment, relieve pressure points, regulate temperature, and minimize sleep disturbances (Levy, Kopplin, & Gefen, 2014), (Bolton et al., 2022), thereby promoting restful sleep essential for overall physical health and well-being these refer to user perceptions of usefulness.

H4: Mattress Property (MP) has a positive effect on Perceived Usefulness (PU)

Perceived Ease of Use is defined as individual's subjective perception of the level of simplicity and user friendliness associated with using a particular technology or system (Davis, 1989). Several prior studies deal with an adopting a new technology, the perceived ease of use is the important factor influencing user acceptance and usage behavior in various digital platforms such as healthcare technologies, in term of multitude of uses and functions (Bari & Abualkibash). Perceived ease of use has the powerful impact related to attitude towards using of new technology, in studies based on TAM, show that this perception positively influences turns user acceptance of mobile banking apps (Prastiawan, Aisjah, & Rofiaty, 2021), e- commerce (Indarsin & Ali, 2017), and the telehealth services (Terry & Buntoro, 2021), however, the studies suggest that it is primary based on the user's technological skills and experiences (Venkatesh, 2000).

H5: Perceived Ease of Use (PEOU) has a positive effect on Attitude toward using (A)

Perceived Usefulness is defined as individual's subjective assessment of the extent to which they believe that using a particular technology or system would enhance their performance and productivity in achieving specific goals or tasks (Davis, 1989), this shows the benefits individual expects to derive from using the technology. This perception influences their attitude towards using the technology and their intention to adopt and continue using it. For example, in healthcare technologies among medical professionals, results indicated that perceived usefulness positively impacted technology acceptance, particularly in enhancing patient care and clinical efficiency (Edo

et al., 2023) and in smart home technologies, results suggested that perceived usefulness was influenced by factors such as convenience, energy efficiency, and home security, driving adoption intentions (Nikou, 2019). In this paper, the perceived usefulness was reflecting user beliefs about the benefits and advantages of adopting a health mattress will greatly improve their sleep quality and physical and mental health. From previous, the two factors: Perceived Ease of Use and Perceived Usefulness are the key components of TAM. Therefore, these variables will be explored in this study.

H6: Perceived Usefulness (PU) has a positive effect on Attitude toward using (A)

Attitude toward using refers to an individual's overall evaluative stance, reflecting the individual's feelings, which can be the positive or negative towards using a particular technology (Inayatullah Fatmawati & Ali). Attitude toward using influencing users' intentions and behaviors on decision making processes, such as adoption, acceptance, and continued usage behavior. The previous researches show that perceived ease of use and perceived usefulness significantly influenced user attitudes, impacting their intention to use mobile banking apps (Indarsin & Ali, 2017), and perceived usefulness, perceived ease of use along with social influence were significant predictors of attitudes towards using fitness trackers (Naglis & Bhatiasevi, 2019), influencing user adoption decisions. And perceived usefulness, perceived physical condition, technological anxiety, user innovativeness, and perceived availability were determinants of healthcare worker attitude toward using digital health technologies (Edo et al., 2023). So, there are diverse factors shaping attitudes towards using across different technological contexts.

H7: The positive impact of attitude toward using (A) on behavioral intention to use (BI) of the health mattress

4. RESEARCH METHODOLOGY

4.1 Data Collection

Technology Acceptance Model (TAM) will be used as a main model, to assess and evaluate the correlations between users and decision makers by study acceptance of technology without considering surrounding individual norms, focusing on various factors that influence acceptance or decision making to adopt new technology or innovation, particularly those directly impacting user acceptance (Davis, 1989). Health Condition, Sleep Quality, Mattress Property and Price were examined as the external factors. And statistical analysis for testing and estimating relationships in research aiming to find causal relationship models involving multiple variables called Structural Equation Modeling (SEM) technique will used in hypotheses testing (Bollen, 1989). All data were collected through an online survey in Thai language among the general population in Thailand interested in using health mattress products to promote various health aspects with a sample size of 300 participants with medical condition and none around Thailand by the age of 18 years and over who are employed in public and private sector and unoccupied. The questionnaire was developed based on literature reviews and related research, divided into 4 sections: Section 1: Personal factors questionnaire, which consisted of closed-ended questions such as gender, age, education level, occupation, and monthly income level. Section 2: Health behavior questionnaire or health data questionnaire, including questions related to familiarity with health mattresses. Section 3: Data on the importance levels of external factor components, which are questionnaire questions about various external factors influencing technology perception affecting acceptance of health mattress technology. These questions were in the form of rating scales, specifically Likert's Scale with 5 rating levels, ranging from 5 (strongly agree) to 1 (strongly disagree). Section 4: Additional suggestions and comments, which were open-ended questions allowing participants to freely express their opinions on acceptance of health mattresses, as well as their needs and suggestions. The research documents were reviewed and approved by Ethics Review Board of Rangsit University with the certificate of approval number COA. No. RSUERB2023-134.

4.2 Data Analysis

The SmartPLS program was used in this research to assess the reliability and construct validity of the model, using a bootstrapping method involving 5,000 repetitions, testing hypotheses about the influences of sets of variables on other variables of the Structural Equation Modeling (SEM). The data shows composite reliability and average variance extracted (AVE) by the Cronbach's alpha related to composite reliability values are over 0.7 and the average variance extracted (AVE) exceeds 0.5 in each construct as recommended value (Cronbach, 1970), (Cheung et al., 2023). Indicates whether the question measures the purpose or content accurately and can be used and indicates that the questionnaire is reliable and valid, suitable for use with actual sample groups.

5. FINDINGS

This study applied quantitative research to analyzes data using questionnaires as a data collection tool, the relevant documents and literature reviews addressed as a methodology for conducting research questions and embed them in guiding research hypotheses. In this research, a survey research method was utilized. Convenience random sampling method was employed to select the sample group. Questionnaires were distributed to the sample group, and data collection was conducted using online questionnaire documents. The data collected from the questionnaires, both multiple-choice and open-ended, were analyzed and presented in tabular and sequential formats.

5.1 Demographic Data of Respondents

The sample of 300 participants responded to the study via an online survey, 55% are men 43% are female and 2% are non-specific with age 18 and older. Of these education level, Bachelor's 57% Master's 29% PhD. 10% while 5% of respondents are high school or less. Occupational class variables included public and private sectors and without occupation which are varying income ranges from a monthly range of below 20,000 Baht and higher. Moreover, Health Information and Health Mattress experiences are involved in this survey to learn about a relation between user's experience in term of general personnel health data and significant health mattress characteristic as shown in the table 1.

Table 2. Demographic Data of Respondents

Item	Demographic Information	Amount	%
Gender	Male	129	43
	Female	164	55
	Neutral	7	2
Age (Years)	18 to less than 25	88	29
	26 to less than 35	72	24
	36 to less than 45	78	26
	46 to less than 55	40	13
	56 to less than 65	18	6
	65 and over	4	1
Education Level	High school and less	15	5
	Bachelor	170	57

	Master	86	29
	PhD.	29	10
Occupation	Employee	76	25
	Self-employed	43	14
	Part-timer	4	1
	Public service	92	31
	Without occupation	6	2
	Others	79	26
	- Retired government official	4	1
	- Student	73	24
	- Lecturer	2	1
Monthly Income	Below 20,000 Baht	108	36
	20,001Baht – 30,000 Baht	59	20
	30,001 Baht – 50,000 Baht	65	22
	50,001 Baht – 70,000 Baht	48	16
	70,001 Baht and over	20	7
Medical Condition	Yes	65	78
	- Neurology	6	2
	- Heart & Vascular	15	5
	- Acute Respiratory Infections	13	4
	- Gastrointestinal	4	1
	- Orthopedic	2	1
	- Otolaryngology	2	1
	- Mental Health	4	1
	- Others(Allergic, Diabetes & Hypertension)	19	6
	No	235	22
Chronic Disease	Chronic	44	68
	Non chronic	21	32
Most important characteristic of Health Mattress (Personnel aspect)	Airflow and prevent overheating	15	5
	Pain relief	79	26
	Prevent dust mites, their allergens, viruses and bacteria	28	9
	Strong and sturdy structure	7	2

	Improve sleep health (sleep quality, snoring)	166	55
	Other	5	2
Mattress Characteristic Selection (Currently use)	Airflow and prevent overheating	15	5
	Pain relief	99	33
	Prevent dust mites, their allergens, viruses and bacteria	26	9
	Strong and sturdy structure	25	8
	Improve sleep health (sleep quality, snoring)	98	33
	Avoid toxic odor	8	3
	Price	15	5
	The above characteristics are not available	14	5

5.2 Construct Reliability and Validity

Table 3. Construct Reliability and Validity

	Cronbach's alpha	Composite reliability (rho_a)	Composite reliability (rho_c)	Average variance extracted (AVE)
A	0.915	0.916	0.946	0.854
BI	0.917	0.918	0.948	0.859
HC	0.779	0.781	0.824	0.61
MP	0.721	0.762	0.838	0.721
P	0.711	0.705	0.779	0.541
PEOU	0.861	0.862	0.915	0.783
PU	0.712	0.708	0.819	0.609
SQ	0.809	0.81	0.887	0.725

Above table shows data of Cronbach's alpha, Composite reliability and Average variance extracted (AVE) to represent reliability and validity. All variables present strong scale reliability and validity, we describe Cronbach's alpha, Composite reliability and Average variance extracted (AVE) as shown in Table 2, where all variables fall within an acceptable range. Cronbach's alpha related to Composite reliability values are over 0.7 (Cronbach, 1970) and the Average variance extracted (AVE) exceeds 0.5 in each construct, indicating an acceptable reliability level (Alrabei, 2023).

5.3 Individual Item Validity (Cross Loading)

Table 4. Individual Item Validity (Cross Loading)

	A	BI	HC	MP	P	PEOU	PU	SQ
A1	0.902	0.831	0.349	0.372	0.251	0.317	0.63	0.614
A2	0.932	0.825	0.332	0.354	0.242	0.374	0.594	0.584
A3	0.939	0.847	0.351	0.324	0.293	0.428	0.657	0.581
BI1	0.842	0.903	0.336	0.368	0.274	0.319	0.591	0.615
BI2	0.849	0.94	0.391	0.317	0.246	0.402	0.668	0.609
BI3	0.817	0.936	0.375	0.28	0.28	0.342	0.639	0.644
HC1	0.278	0.328	0.755	0.276	0.232	0.346	0.375	0.461
HC2	0.258	0.262	0.833	0.218	0.082	0.379	0.218	0.277
HC3	0.335	0.339	0.752	0.196	0.256	0.383	0.347	0.332
MP1	0.25	0.253	0.312	0.798	0.326	0.193	0.365	0.371
MP2	0.377	0.33	0.206	0.898	0.444	0.122	0.5	0.435
P1	0.265	0.214	0.24	0.245	0.719	0.185	0.352	0.378
P2	0.196	0.238	0.15	0.377	0.801	0.153	0.395	0.298
P3	0.16	0.175	0.143	0.406	0.71	0.087	0.286	0.234
PEOU1	0.34	0.292	0.458	0.175	0.197	0.883	0.284	0.37
PEOU2	0.414	0.393	0.378	0.205	0.192	0.873	0.347	0.359
PEOU3	0.318	0.33	0.421	0.089	0.132	0.898	0.252	0.313
PU1	0.636	0.652	0.403	0.334	0.342	0.334	0.877	0.625
PU2	0.305	0.26	0.182	0.696	0.36	0.069	0.707	0.417
PU3	0.598	0.622	0.32	0.282	0.419	0.328	0.855	0.622
SQ1	0.482	0.524	0.389	0.405	0.4	0.276	0.604	0.812
SQ2	0.548	0.57	0.392	0.425	0.366	0.35	0.63	0.871
SQ3	0.607	0.62	0.375	0.388	0.299	0.379	0.608	0.869

The table above displays data on Cross Loading. The analysis of discriminant validity using cross loading involves examining the cross-loading criteria, the relationships between the outer loadings of indicator variables of a latent variable and comparing them with those of other latent variables in the model which is set to be greater than or equal to 0.7.(F. Hair Jr et al., 2014). When considering the relationships between them, it is found that the correlation values are at a level lower than expected as found in Table 3, so all latent variables exhibit discriminant validity based on the cross-loading criteria.

5.4 Fornell-Larcker Criterion

The Fornell-Larcker criterion is designed to assess the discriminant validity of constructs in a measurement model, involves comparing the AVE by taking the square root between latent variables with other latent variables, should be at least 0.7, and each latent variable should have values higher than the AVE between that latent variable and other latent variables squared (Fornell & Larcker,

1981). As Table 4 shows, the average extracted variance of the same latent variable is higher than its relationship with other latent variables.

Table 5. Fornell-Larcker Criterion

	A	BI	HC	MP	P	PEOU	PU	SQ
A	0.924							
BI	0.903	0.927						
HC	0.372	0.397	0.781					
MP	0.378	0.348	0.293	0.849				
P	0.284	0.288	0.242	0.46	0.736			
PEOU	0.404	0.383	0.474	0.178	0.197	0.885		
PU	0.679	0.683	0.399	0.518	0.475	0.333	0.78	
SQ	0.642	0.672	0.453	0.477	0.417	0.394	0.722	0.851

5.5 Heterotrait-Monotrait Ratio (HTMT)

The table below indicates that the Heterotrait-Monotrait Ratio of Correlations (HTMT) reveals that none of the HTMT values exceed the threshold of 0.90. (Henseler, Ringle, & Sarstedt, 2015). Table 5 displayed the outcomes of the HTMT evaluation, demonstrating satisfactory discriminant validity, with the highest HTMT values reaching 0.865, falling below the threshold value of 0.90.

Table 6. Heterotrait-Monotrait Ratio (HTMT)

	A	BI	HC	MP	P	PEOU	PU	SQ
A								
BI	0.785							
HC	0.472	0.504						
MP	0.489	0.453	0.471					
P	0.386	0.39	0.388	0.762				
PEOU	0.454	0.43	0.618	0.251	0.272			
PU	0.854	0.85	0.588	0.865	0.775	0.417		
SQ	0.746	0.78	0.617	0.668	0.603	0.47	0.782	

5.6 Collinearity (VIF)

Table 7. Collinearity (VIF)

	VIF
A1	2.601
A2	3.756
A3	3.895
BI1	2.586

	VIF
BI2	4.156
BI3	4.095
HC1	1.363
HC2	1.525
HC3	1.242
MP1	1.255
MP2	1.255
P1	1.101
P2	1.266
P3	1.253
PEOU1	2.164
PEOU2	2.057
PEOU3	2.489
PU1	1.86
PU2	1.091
PU3	1.806
SQ1	1.535
SQ2	1.996
SQ3	2.011

Variance Inflation Factor (VIF) used to test for the presence of multicollinearity among the predictor variables, where they should not exhibit significant correlations with each other. The VIF values are recommended to be below 5.00 to indicate acceptable levels of multicollinearity (Hair, 2009). When examining Table. the VIF values ranging from 1.091 to 4.156, this implies that SEM for this research does not encounter issues with multicollinearity among the external predictor variables, as indicated in Table 6.

5.7 Structural Model Results

Table 8. Structural Model Results

Path coefficients	Original sample (O)	Sample mean (M)	Standard deviation (STDEV)	T statistics	P values
A -> BI	0.903	0.902	0.015	62.044	0.000
HC -> PEOU	0.474	0.478	0.050	9.397	0.000
MP -> PU	0.172	0.171	0.058	2.969	0.003
P -> PU	0.156	0.160	0.048	3.245	0.001
PEOU -> A	0.200	0.200	0.051	3.948	0.000
PU -> A	0.612	0.613	0.054	11.392	0.000
SQ -> PU	0.575	0.573	0.056	10.261	0.000

To assess the structural model, we employed bootstrapping with 5,000 iterations at a significance level of 0.05 ($p < 0.05$) (Tibshirani & Efron, 1993). From Table 7, illustrate the analysis of path coefficients for the hypotheses and there are seven path coefficients of all statistically significant t-values greater than 1.96 (for a 95% confidence level) and p-values less than 0.05, and thus the seven hypotheses of this sub model are validated. The values linked to the asymptotic significance p and t test for the seven hypotheses within the structural sub model shown as, the relationship between Health Condition (HC) and Perceived Ease of Use (PEOU) ($t = 9.397$, $p < 0.05$), Sleep Quality (SQ) and Perceived Usefulness (PU) ($t = 10.261$, $p < 0.05$), Price (P) and Perceived Usefulness (PU) ($t = 3.245$, $p < 0.05$), Mattress Property (MP) and Perceived Usefulness (PU) ($t = 2.969$, $p < 0.05$), Perceived Ease of Use (PEOU) and Attitude (A) ($t = 3.948$, $p < 0.05$), Perceived Usefulness (PU) and Attitude (A) ($t = 11.392$, $p < 0.05$) and Attitude (A) and Behavioral Intention to Use (BI) ($t = 62.044$, $p < 0.05$).

Figure 2 illustrated the final operational model in structural equation model (SEM) performed by the SmartPLS program along with a round of random sampling using the bootstrap method repeated 5,000 times. Of the seven hypotheses, there are all supported. By observing the finding it shows that Health Condition influence an increase in Perceived Ease of Use, Sleep Quality, Price and Material Property influence an increase in Perceived Usefulness, Perceived Ease of Use and Perceived Usefulness influence an increase in Attitude and Attitude influence an increase in Behavioral Intention to Use.
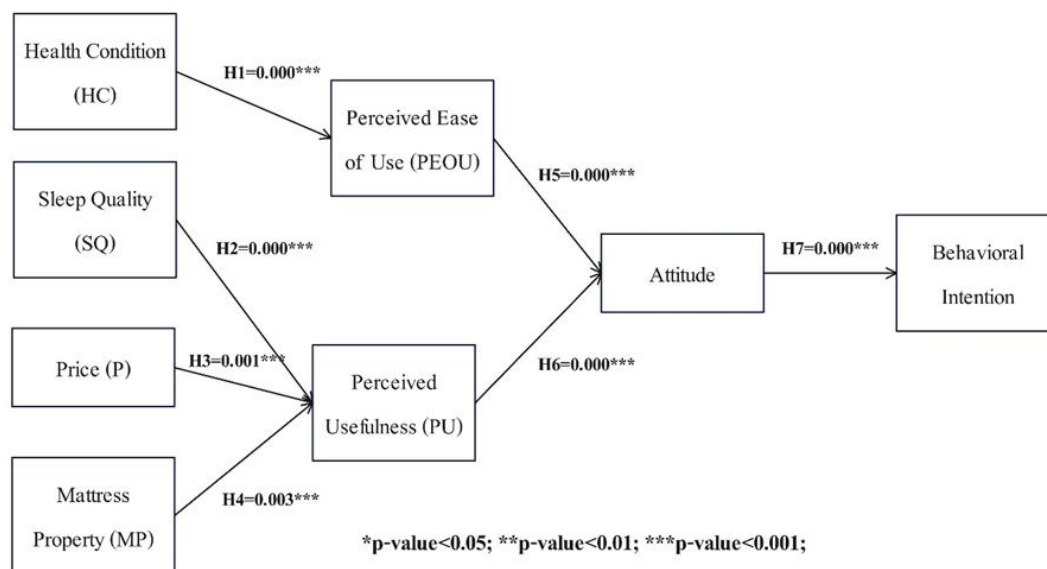

Fig.2: Summary of hypothesis testing results

6. DISCUSSION

6.1 Comparisons between a proposed research model and previous works
The research has identified the primary need for health mattress usage in terms of sleep quality, coupled with health-related aspects such as body discomfort and fatigue. Additional feedback from research participants revealed an increasing expectation for health mattress usage, particularly in innovative pressure ulcer prevention technology for patient or elderly groups, which showed a growing trend. Based on previous research studies on health mattresses, it has been shown that

health mattresses are used for health and sleep purposes. The studies analyze and compare the use of health mattresses in daily life or for therapeutic purposes to test whether health mattresses can address these issues compared to regular mattresses. Therefore, this research considers various factors including mattress property, health condition, sleep quality and price to study the process of technology acceptance and behaviors that affect the effectiveness of health mattresses, these factors will help support decision making in choosing health mattresses more easily. Additionally, there were also additional suggestions to integrate health monitoring technology during sleep to detect abnormal sleeping positions or breathing patterns, thus enhancing the effectiveness of health mattress related usage. Currently, there is insufficient data to adequately define the market conditions for health mattress or data to build consumer confidence in health mattress remains limited. These data are essential for both consumers and manufacturers. For consumers, it enables them to confidently use data for decision making and selecting health mattress that meet their health needs. Simultaneously, manufacturers can sufficiently understand consumer needs to deliver innovative health mattress tailored to their requirements.

6.2 Implication to theories and practice of health mattress process

Production of Health Mattresses using THAI SMEs STANDARD No.44-2562 shown in Figure 3. The latex with a DRC of approximately 60% is fed into a foaming machine to control the foam density according to the specified formula. The production process begins by injecting the latex foam into molds of various shapes. The molds filled with latex foam are then placed in a steam oven. This step involves vulcanization using steam to strengthen the foam structure. The process takes 45-60 minutes at a temperature of 90-100°C, depending on the product thickness then the latex products are removed from the molds and cleaned to remove any residual chemicals on the surface. The cleaned latex products are then dried in a drying oven for the specified time to ensure they are dry and moisture free and the products undergo quality inspection and testing according to the THAI SMEs STANDARD no.44-2562. by checking product dimensions and mechanical properties that affect ergonomic use. Products that pass the tests are packaged and shipped according to orders. Those that fail are either destroyed or repurposed.

This quality criteria for latex foam rubber mattresses to be used as an industry standard for SMEs, promoting and elevating this type of industry to ensure high and consistent quality, recognized in both domestic and international markets.
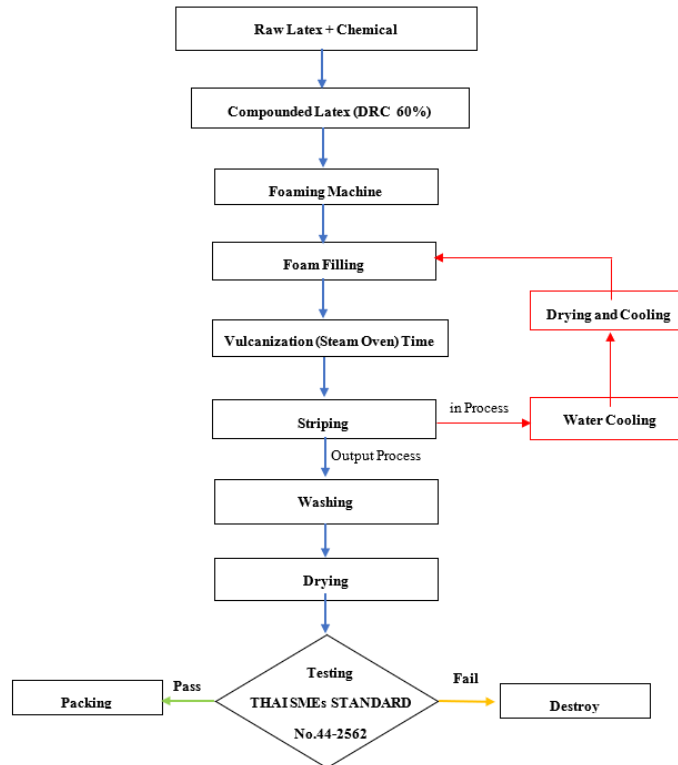
Fig. 3 Health Mattress Process

Table 9 below shows mapping between the factors of the model and the production process, indicating which factor is related to which stage, Health Condition affects the Initial, Compounded Latex, Foaming Machine, Washing, and Testing stages because these stages influence the physical conditions that may impact the health of users of health mattresses. Sleep Quality affects the Initial, Compounded Latex, Foaming Machine, and Testing stages because these stages influence the duration of sleep and the time spent on the mattress, which affects the sleep quality of health mattress users. Price affects all stages because every stage influences the price, reflecting the value of the health mattress product and the decision to use it. Mattress Property affects the Initial, Compounded Latex, Foaming Machine, Vulcanization, and Testing stages because these stages directly impact the mattress properties, representing the product quality, users will evaluate the product quality by considering important properties, components, or technical features of the product, thereby building confidence in choosing a health mattress. Perceived Ease of Use and Perceived Usefulness affect the Initial and Testing stages because they are crucial factors influencing product expectations, corresponding to the intended use and benefits anticipated by users. Attitude and Behavioral Intention primarily affect the Testing stage, as product testing verifies whether the product performs as expected and is free from defects, ultimately reflecting user acceptance.

Table 9. A New Acceptance Model for Health Mattresses applies to the Health Mattress Production Process

Process / Acceptance	Health Mattress Production Process							
	Initial	Compounded Latex	Foaming Machine	Vulcanization (Steam Oven) Time	Striping	Washing	Drying	Testing
Behavior Intention								✓
Attitude								✓
Perceived Usefulness	✓							✓
Perceived Ease of Use	✓							✓
Mattress Property	✓	✓	✓	✓				✓
Price	✓	✓	✓	✓	✓	✓	✓	✓
Sleep Quality	✓	✓	✓					✓
Health Condition	✓	✓	✓			✓		✓

(Row group label: A New Acceptance Model for Health Mattresses)

7. CONCLUSION

This paper aims to assess the Structural Equation Model (SEM) for the Factors Influencing Acceptance of Technology for Health Mattress using the SmartPLS program with a sample size of 300 participants with medical condition and none around Thailand with the age 18 years and over who are employed in public and private sector and unoccupied. Focusing on study factors related to the acceptance of health mattress technology, to develop and design a Conceptual Model including a SEM of the technology acceptance process, as well as behaviors that impact the sleep efficiency and health which are the majority element of health mattress. Furthermore, other elements related to health mattress have been collected beyond those mentioned above. These elements as the external factors encompass aspects such as Mattress Property, Health Condition, Sleep Quality, and even Pricing, reflecting economic value. In this paper, TAM was analyzed as a main framework in order to examine various factors influence the acceptance or decision to use new technology or innovation, such as this health mattress, considering external factors, the influence of these external factors is created by perceptions that vary among individuals, affecting perceptions in two aspects: Perceived Usefulness and Perceived Ease of Use. These, in turn, affect Attitudes toward using and eventually influence Behavioral Intention to use. Importantly, the factor of Mattress Property in this research has been included to study technology acceptance process, in previous researches, mattress property has been heavily emphasized for post usage testing to analyze how the properties of a health mattress contribute to health or sleep improvement. The result shows that all variables are significant influence towards the Behavioral Intention to Use the health mattress. Moreover, analyzing these external factors can provide a better understanding of the context of consumer health mattress usage.

Institutional Review Board Statement

 This study was approved by the Ethics Review Board of Rangsit University, with the certificate of approval number COA. No. RSUERB2023-134.

Informed Consent Statement

All participants provided written, informed consent before answering the question in this study and voluntarily participated after the researcher assured them of anonymity and that their responses were solely for academic purposes.

Data Availability Statement

The data analyzed in this study cannot be shared publicly because of the Personal Data Protection Act and is managed by the Ethics Review Board of Rangsit University, with the certificate of approval number COA. No. RSUERB2023-134.

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Conflicts of Interest:

The authors declare no conflicts of interest.

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