ASEAN Journal of Management & Innovation
Vol. 10. No.2, 74 - 81

DOI: 10.14456/ajmi.2023.14
ajmi.stamford.edu
Received: March 4, 2023
Revised: July 4, 2023
Accepted: August 3, 2023

Applying the Analytical Hierarchy Process (AHP) and Delphi Method to Identify the Criteria for the Selection of Healthcare Chatbots in Thailand

Sirirak Phooriyaphan
PHD.Student in Sustainable Industrial Management Engineering Department, Faculty of Engineering, Rajamangala University of Technology Phra nakorn, Thailand
SIRIRAK-PH@rmutp.ac.th
Natworapol Rachsiriwatcharabul
Lecturer in Sustainable Industrial Management Engineering Department, Faculty of Engineering, Rajamangala University of Technology Phra nakorn, Thailand
natworapol.r@rmutp.ac.th

Abstract
Healthcare chatbots can be used for many purposes such as, for example, sharing information, and scheduling appointments. They can also reduce costs and improve patient satisfaction. This research seeks to determine the criteria to be applied by Thai organizations for the successful selection of medical chatbots, assess their respective weight, and come up with a model for selecting them. Data was collected from a review of the relevant literature and from interviews with nine experts and analyzed using the IOC concept and Delphi method. The criteria were categorized and structured based on the Analytic Hierarchy Process (AHP). Three main selection criteria were identified, the most significant one being security and privacy (42%), followed by user satisfaction (34%) and system design (24%). These three criteria could serve as guidelines using a multi-criteria decision-making approach.

Keywords: Healthcare Chatbot, Analytic Hierarchy Process (AHP), Delphi Method

Introduction

Today, chatbots are widely used across the globe. As communication tools, they have been encountering enormous success in areas such as product and service sales, marketing, entertainment, and public administration (Makasi et al., 2021). In the entertainment industry, chatbot technology has the potential to improve conversion for subscription services (Imperson, 2020). Chatbots can also deliver personalized and targeted marketing messages and ultimately increase revenues (Kooli, 2023). The use of chatbots has been especially influential in relation to public administration matters (Nirala, Singh, & Purani, 2022). Moreover, medical chatbots are used for various purposes such as providing information, making appointments, or establishing medical records to name a few. This comes in addition to surgery robots and teleconference visits, which are fast emerging (Usak et al., 2019). Medical chatbots have the potential to play a major role in optimizing resources. The healthcare chatbot market is expected to grow worldwide from USD184.60 million in 2021 to USD431.74 million by 2028 at a CAGR of 15.20 % (Vantage Market Research, 2022). Acceptance by patients, however, still remains somewhat of a question mark as their quality has yet to be demonstrated and measured (Nadarzynski et al., 2019). This is

especially the case in Thailand where in spite of the trend-accelerating effect of the Covid-19 pandemic, medical chatbots have yet to gain full currency (Sitthipon et al., 2022). In spite of the enormous success of chatbots in areas such as product and service sales, marketing, entertainment and public administration, chatbots are still comparatively not widespread in the clinical field because of the critical nature of the elements used for depth assessment (the responsibility for patients' health and the risks involved) (Santa Barletta, 2022). The purpose of this research is to identify criteria for selecting healthcare chatbots in Thailand by using a multi criteria decision making approach. These criteria could serve as guidelines and provide a decision support system to select healthcare chatbots in the future.

2. Literature Review

- *Chatbots*

Chatbots are software applications that use AI and natural language processing to understand what humans want and guide them to their desired outcome with as little work for the end user as possible (Cylsy Software, 2023). An AI Chatbot can understand language outside of a set of pre-programmed commands and continue learning based on the inputs it receives. Chatbots have been designed to address a plethora of domains (Abdullah, 2020; Staven, 2017). They can be applied to a range of uses from sentiment analysis to making predictions about what a visitor is looking for on a platform. For example, they can act like a virtual assistant in providing customer experience touchpoints. Chatbots are in high demand in the business sector, where customer service plays a key role in ensuring customer satisfaction and repeat business, as they can do uninterrupted work and handles clients and offer 24/7 support. (Richki & Nanna, 2020). Indeed, as virtual assistance, they provide genuine feedback support to clients. There has been an effort to increase security using chatbots. Using MAC Address Authentication for customer service quality is the first stage in the security process that will be checked by the system before proceeding to the next security stage (Usak et al., 2019).

- *Healthcare (Medical) Chatbots*

Many chatbots have been developed for healthcare purposes (Safi et al., 2020). Medical chatbots can be defined as AI-powered conversational solutions meant to help patients, insurance companies, and healthcare providers easily connect with each other (Phooriyaphan & Rachsiriwatcharabul, 2022). They can play a critical role in making relevant healthcare information accessible to the right stakeholders at the right time (Safi et al., 2020). More specifically, they can help provide primary care by generating automated responses based on user interaction and by determining the cause of patients' symptoms. In addition, they can contribute to developing and maintaining a good relationship between patients and the healthcare system and ensure customer satisfaction (Santa Barletta, 2022). Moreover, healthcare chatbots can also help to monitor the behavior of patients. Although hesitancy regarding this technology is likely to compromise engagement in the short term, healthcare chatbots are slated to become even smarter in the future cover more medical situations (Nadarzynski et al., 2019). This is all the more the case as users will eventually be receptive to using health chatbots. Designer of AI-led health chatbots, however, need to adopt a user-centered approach that addresses patients' concerns and optimize user experience (Gupta & Agarwal,2019; Safi et al., 2020).

- The Analytic Hierarchy Process (AHP)

The Analytic hierarchy process (AHP) was developed by Thomas Satty in 1980. It is a structured technique for organizing and analyzing complex decisions, based on mathematics and psychology (Satty,1980).

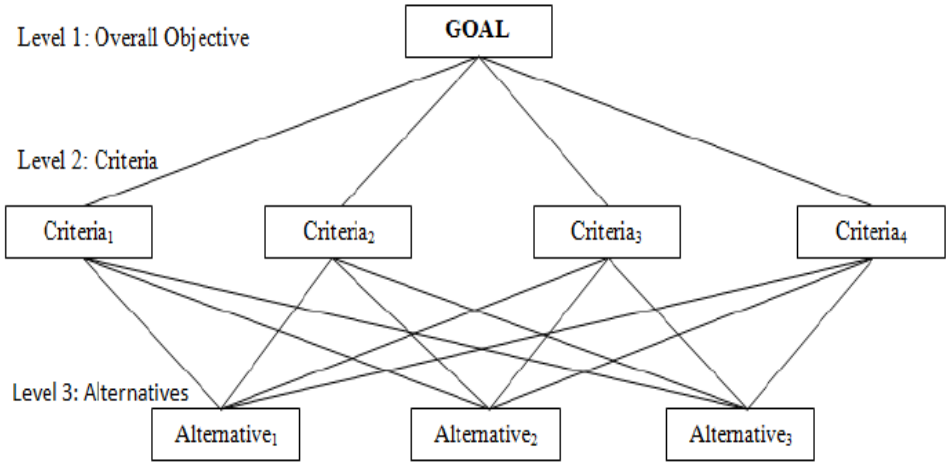

Figure 1: AHP Structure (Source: https://www.researchgate.net/figure/General-hierarchystructure-of-AHP_fig2_264436283, 2022)

The AHP is used by academics and practitioners in decision making problems (Satty & Peniwati, 2008). The AHP divides the decision-making process into the following four steps:

1. Identification and decomposition of the problems into a hierarchical form to represent overall objectives, criteria, and alternatives.
2. Comparison of the pairs of structure elements in order to determine the significance of the different elements at each level. The scale used in comparison with corresponding numeric values ranges from 1 to 9 as shown in Table 1.

Table 1: Pairwise Comparison AHP Scale (Satty,1980)

Scale	Definition
1	Equally important
3	Moderately important
5	Strongly important
7	Very strongly important
9	Extremely important
2, 4, 6, and 8	Intermediate values between the two adjacent judgments

3. Synthesis of the overall priorities. The goal is to assess the significance of each level of the hierarchical structure. The overall priorities of the criteria are synthesized.
4. Consistency test – The consistency of the pairwise comparisons must be checked. The consistency index (CI) and the consistency ratio (CR) are used for measuring the consistency judgment for each comparison. The CR is acceptable if it does not exceed 0.10

(Satty, 1990). The formula is applied to calculate the consistency rate as follows: CR = CI/ CR.

- *The Delphi Method*

The Delphi method is a formal, in-depth systematic qualitative methodology which was first studied by a team at the RAND Corporation in 1950, who made multiple practical applications of the method (Dalkey & Helmer, 1963). The Delphi method utilizes structured anonymous communication between experts in order to gather consensus perspectives about an issue or a topic that can then be translated or used to inform decision making about a specific issue or within a specific context (Birdsall, 2004; Dalkey & Helmer, 1963). Specifically, the method is used to collect expert bases judgments and identify consensus. It represents a method for aggregating group judgements that is able to increase decision making efficiency.

3. Research Methodology

The aim of this research is to develop a conceptual framework for identifying criteria and setting priority for the selection of healthcare chatbots in Thailand by using AHP, and the Delphi method. For this mixed methodology study, data were collected from literature review and from experts who shared their opinions. The data obtained was analyzed by using the concept of IOC and the Delphi method and the remaining factors were categorized and structured based on the AHP concept. Three main criteria were identified: (1) system design (2) user satisfaction and (3) security and privacy. Thirteen sub-criteria were also identified. Questionnaires were then put together and distributed to 9 experts who included practitioners in public healthcare organizations, chatbot developer companies, and academia, all of whom chosen on the basis of their profession, work experience, and research activities. As stated by Satty (2001), a small sample size (less than 10) is acceptable if the data is collected from experts.

.

4. Results

The results relate to the AHP structure, the findings from the interviews, and the significant weights of each criterion.

- *AHP Structure*

Table 2 shows the data collected from the literature review and related research.

Table2: Criteria for Selecting Healthcare Chatbots

Researcher/ Year of Research	Criteria
Parkam (2022)	Wide accessibility, ease of use, fast in information dissemination
Richki & Nanna (2020)	Security
Gupta (2019)	User friendly, feedback support
Vyas (2017)	Speed of response time
Eeuwen (2017)	User friendly, Protect and respect privacy
Saengchai, Pattanapongthorn, & Jernsitipasert (2019).	Dealing with unexpected questions
Kulligowska (2015)	Accurate replies
Lin & Hsieh (2011)	Functionality, enjoyment, security and privacy, assurance, design, convenience, and customization

Three main criteria were identified: (1) system design (2) user satisfaction and (3) security and privacy. Figure 2 shows the AHP structure of the healthcare chatbot selection based on these three main criteria.

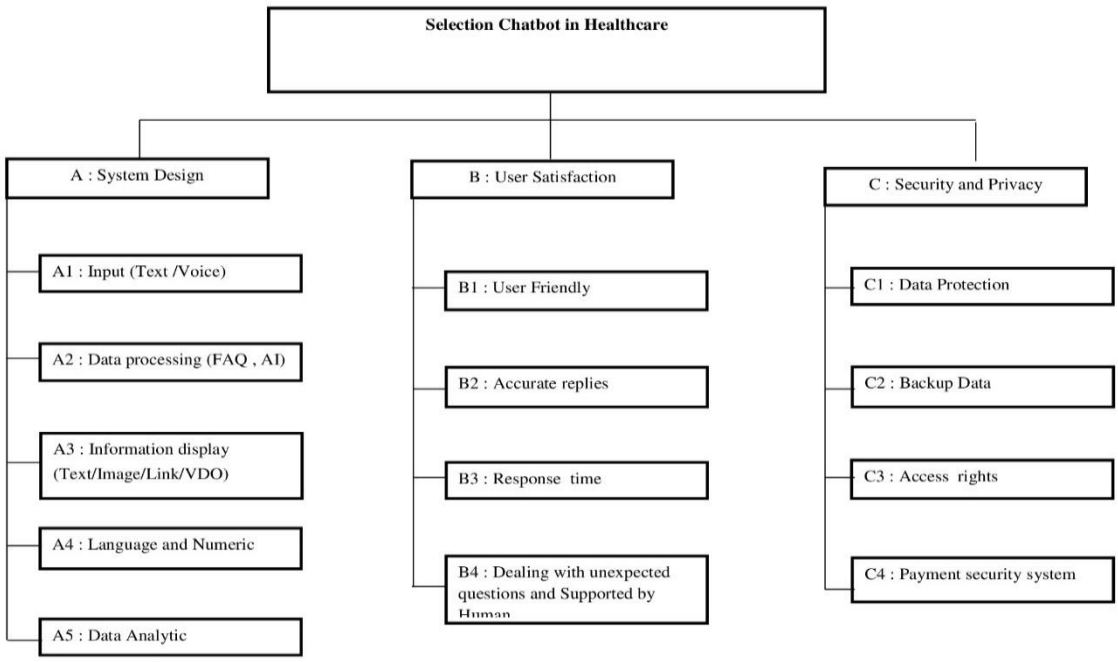

Figure 2: AHP Structure for the Selection of Healthcare Chatbots

- *AHP Application to Determine Healthcare Chatbot Criteria*

Table 3 reports the selection criteria. As noted above, three main criteria and thirteen sub-criteria were identified. The factor affecting the selection from the literature review and opinion of experts.

Table 3: Selection Criteria

Main criteria	Sub criteria
System Design	Input Data Processing Information display Language and numeric Data analytic
User Satisfaction	User friendly Accurate replies Response time Dealing with unexpected questions and supported by human
Security and privacy	Data protection Back up data Access rights Payment security system

As indicated in Table 4, the results show that the most significant success criterion is Security and Privacy with 42 percent, followed by User Satisfaction (34%) and System Design (24%) respectively. Regarding the security and privacy criteria, data protection is the highest factor (39%). In respect to the user satisfaction criteria, accurate replies are the most important factor with 49.60 percent. As to the system design criteria, data processing represents the highest factor (26.30%/).

Table 4: AHP Results

Main Criteria	**Sub Criteria**	Scores
Security and privacy (42%)	Data protection	39.00%
	Back up data	10.00%
	Access rights	26.00%
	Payment security system	25.00%
User Satisfaction (34%)	User friendly	15.20%
	Accurate replies	49.60%
	Response time	20.20%
	Dealing with unexpected questions and supported by human	15.00%
System design (24%)	Input	22.00%
	Data Processing	26.30%
	Information display	17.00%
	Language and numeric	9.00%
	Data analytic	25.7%

Discussion and Conclusion

The use of chatbots in the healthcare sector in Thailand is growing, albeit at a low rate. Medical chatbots serve many purposes such as, for example, providing information and recording patient appointments. They help organizations to reduce costs and patients to communicate better with hospitals. However, finding suitable chatbots that have the required standards and technology and meet customer satisfaction within the context of the Thai culture and its own specificities remains a challenge. It is imperative that the healthcare industry understands the criteria for selecting chatbots so that decision they match patients' expectations. As the investigation conducted in this paper indicates, security and privacy are paramount concerns across the board and the most significant criteria to be taken into consideration when selecting medical chatbots in the Thai healthcare industry. Data collected as part of healthcare procedures must be kept private and their access limited to patients and practitioners, which, as pointed out by Richki and Nanna (2020), requires putting in place a reliable sophisticated computer security system. This involves high data protection and limited access rights as healthcare data are sensitive data, which patients clearly wish to keep private and out of reach of outsiders.

The criteria to be taken into consideration, however, are just limited to patients. Healthcare practitioners also have strong expectations regarding medical chatbots and the way they can be used to ensure maximum efficacy. For one, they do expect chatbots to be user friendly, be highly responsive (short response time) and be able to dela with unexpected questions as not every case is a standard case. In short, in the selection process, healthcare organizations should be extremely mindful of user satisfaction. This is in line with Eeuwen's (2017) findings, whose study also showed that what is therefore required is a strong and relevant system design that meets local needs and cultural specificities. These three criteria must be incorporated in the decision-making process

of healthcare organizations if they as well as patients are to benefit from medical chatbots to the utmost. This study was conducted in public hospitals, which provides limitations and may hinder with its generalizations as private hospitals represent a significant segment of the healthcare industry in Thailand. There may be significant differences in views and perception of medical chatbots in private hospitals. Therefore, future research should consider analyzing both types of hospitals together.

References

Abdullah, F. (2020). *Dataset and a Prototype System for Healthcare Chatbot.* International Conference of Data Science, Artificial Intelligence, and Business Analytic at Medan, Indonesia. Retrieved February 7, 2023, from https://www.https://ocs.usu.ac.id/databia/databia2020

Birdsall, I. (2004). It seemed like a good idea at the time: The forces affecting implementation of strategies for an information technology project in the Department of Defense. *Digital Abstracts International, 65,* 2756 (UMI No. 3142229).

Cylsy Software (2023). Chatbot. Retrieved November 3, 2023, from https://www.cylsys.com/

Dalkey, N., & Helmer, O. (1963) An experimental application of the Delphi method to the use of experts. *Management Science, 9*, 458-467.

Eeuwen, M. (2017). *Mobile Conversational Commerce: Messenger Chatbots as the Next Interface between Businesses and Consumers* (master's thesis). University of Twente, Netherlands.

Gupta, J. K., & Agarwal, S. (2019). An epitome of chatbot: A review paper. *International Journal of Computer Sciences and Engineering*, *7*(1), 633-636.

Imperson. (2020). 3 Ways Chatbots are Transforming the Entertainment Industry. Retrieved July 3, 2023, from https://www.imperson.com/

Kooli, C. (2023). Chatbots in education and research: A critical examination of ethical implications and solutions. *Sustainability, 15*(7): 5614.

Kulligowska, K. (2015). Commercial chatbots: Performance evaluation, usability metrics and quality standards of embodied conversational agents. *Professionals Center for Business Research, 2*(2), 1-16.

Lin, J.-S. C, & Hsieh, P.-L. (2011). Assessing the self-service technology encounters: development and validation of SSTQUAL scale. *Journal of Retailing, 87*(2), 194-206.

Makasi, T, Nilli, A., Desiuza, K. C., & Tate, M. (2021). A typology of chatbots in public service delivery. *IEE Software*, *39*(3), 58-66.

Phooriyaphan, S., & Rachsiriwatcharabul, N. (2022). Identifying the criteria for the selection of healthcare chatbots in Thailand using a multi-criteria decision-making approach. *Journal of Positive School Psychology, 6*(5), 3757-3763.

Nadarzynski, T., Miles, O., Cowie, A., & Ridge, D. (2019). Acceptability of artificial intelligence (AI)-led chatbot services on healthcare: A mixed-methods study. *Digital Health, 5*(1), 1-12.

Nirala, K. K., Singh, N. K., & Purani, V. (2022). A survey on providing customer and public administration-based services using AI: Chatbot. *Multimedia Tools and Applications, 81*(2), 1-32

Parham, A. E. K. (2022). Chatbot use cases in the Covid-19 public health response. *Journal of the American Medical Informatics Association. 29*(5), 1000-1010

Richki. A. H., & Nanna, N. S. (2020). Enhanced security framework on chatbot using Mac address authentication to customer service quality. *International Journal of Scientific &Technology Research, 9*(10), 129-135.

Saengchai, S., Pattanapongthorn, J., & Jernsitipasert, K. (2019). The role of subjective norms on the adoption of information and communication technology in healthcare in Thailand. *International Journal of Innovation, Creativity and Change, 9*(8), 256-276.

Safi, Z., Abd-Alrazaq, A., Khalifa, M., & Househ, M. (2020). Technical aspects of developing chatbots for medical applications: Scoping review. *Journal of Medical Internet Research, 22*(12), 1-11.

Santa Barletta, V. (2022). *New Perspectives for Cyber Security in Software Development: When End-User Development Meets Artificial Intelligence.* International Conference on Innovation and Intelligence for Informatics, Computing, and Technologies (3ICT), 531-534.

Satty, T. L. (1980). *The analytic hierarchy process: Planning, priority setting, resources allocation.* New York: McGraw.

Satty, T. L. (1990). How to make a decision: The analytic hierarchy process. *European Journal of Operational Research,48*(1), 9-26.

Satty, T. L. (2001). An ERP software selection process using artificial neural network based on analytic network process approach. *Expert Systems with Applications, 36*(5),9214-9222.

Satty, T. L., & Penwiwati, K. (2008). *Group decision making: Drawing out and reconciling differences*. Pittsburgh, PA: RWS Publications.

Sitthipon, T, Siripipatthanakul, S., Phayaphrom, B., & Siripipattanakul, S. (2022). Determinants of customers' intention to use healthcare chatbots and apps in Bangkok, Thailand. *International Journal of Behavioral Analytics, 2*(2), 1-15.

Staven, T. (2017). What Makes a Good Bot (or Not)? Unit 4 Newsletter. Retrieved March 23,2022, from https://www.linkedin.com/

Usak, M., Kubiatko, M., Shabbir, M. S., Dudnik, O. V., Jermsitiparsert, K., & Rajabion. L. (2019). Health care service delivery based on the Internet of Things: A systematic and comprehensive study. *International Journal of Communication Systems, 32*(14), 1-17

Vantage Market Research (2022). Healthcare Chatbot Market. Retrieved January 23, 2023, from http:// www.vantagemarketresearch.com

Vyas, B. (2017). Key Metrics to Measure the Performance of Your Chatbot. Retrieved February 12, 2023, from https://www.linkedin.com/pulse/6-key-metrics-measure-performance-your-chatbot-binny-vyas