Abstract

Nowadays, innovation is considered as a major source to create competitive advantages of organizations across sectors. Especially, the evolution of a bunch of modern technologies such as internet of things, artificial intelligence, and blockchain that results in the higher customers' expectations of new values in their daily consumed products or services. That has forced organizations to increasingly apply advanced technologies into their production of new or improved products or services to better satisfy market needs, increase customer satisfaction, and ultimately achieve higher business performance. In this context, banks have also been placed innovation as a top priority in their strategies by taking advantages of new technologies to innovate their services.

In the era of innovation, the innovation capability (IC) evaluation becomes necessary to banking organizations since it helps banks broadly review their innovation management process and then be able to modify their innovation strategies. IC is typically a multi-criteria concept according to that banks have to take into account a variety of innovation management practices (IMPs) related to strategies, resources, technologies, knowledge, etc. to comprehensively develop their IC. Under the limited resources, banks should intelligently invest into the more significant IMPs first. Therefore, an IC evaluation method is required to clarify the different importance of IMPs in banking innovation, the maturity degrees of IMPs at banks to be evaluated, as well as the current status of IC of banks which will be a useful basis for proposing effective innovation strategies.

This research develops a four-stage methodology for evaluating IC in banking under uncertainty using multi-criteria decision making approaches. In particular, the first stage is to extract a list of vital IMPs (VIMPs) from the prior studies based on Pareto analysis. The measurement indicators for these VIMPs (sub-VIMPs) are also adapted from the literature. In the second stage, the Analytic Hierarchy Process (AHP) is applied to determine the relative importance weights of VIMPs and their corresponding sub-VIMPs relying on the opinions of experts who works in banking-related fields. In the

third stage, measurement for sub-VIMPs at the evaluated banks is conducted using a questionnaire sent to experts who work independently from the evaluated banks. The data is then formulated in both numeric and linguistic forms. In the final stage, the numeric data is aggregated to derive the overall IC evaluation using weighted sum and the linguistic data with uncertainty is aggregated using the Evidential Reasoning (ER) approach in terms of the Dempster–Shafer theory of evidence. Finally, the aggregated evaluations of IC of banks are used for ranking.

To demonstrate the feasibility of the proposed methodology, it was applied into a case study of three bank in Vietnam. In addition, we also develop alternative approaches to fully understanding the IC of banks by using a data-driven IC evaluation method based on the Data Envelopment Analysis (DEA) model and a customer-driven service innovation evaluation.

This research contributes to the literature by conducting a comprehensive literature review on IMPs and proposing a new integrated methodology based on combining the AHP and the ER approach in terms of Dempster-Shafer theory of evidence for IC evaluation in banking under uncertainty. As for practical implications, the research findings could be the guidance for banks to adjust their innovation strategies toward focusing on the more important VIMPs in order to more efficiently upgrade their IC.

Keywords: innovation capability, evaluation, banking, uncertainty, Analytic Hierarchy Process (AHP), Evidential Reasoning (ER) approach.