https://doi.org/10.31705/BPRM.v3(1).2023.8

REVIEW OF METHODOLOGIES USED IN ELECTRICITY SUPPLY AND DEMAND FORECASTING

The electricity market is a critical component of modern society, providing the essential energy needed to power our homes, businesses, and industries. European countries began to liberalize their electricity markets in an effort to increase competition and reduce prices for consumers (Sousa & Soares, 2020). In a liberalized electricity market, electricity is treated as a tradable commodity like any other product. This implies that European electricity markets are subject to the same economic principles of supply and demand as other markets, with prices rising when demand outstrips supply and falling when supply exceeds demand.

Addition of renewable generation, active demand-side management, and several other developments have changed the dynamics of electricity market. These changes made electricity demand/supply as well as prices more turbulent and less predictable (Hong & Fan, 2016). The intermittency of electricity generation from renewable sources has created several market complexities. This has led to more focus on efficiency-driven interventions in the market (Goodarzi et al., 2019). Based on the time frame the electricity prices have been forecast, electricity market is divided into two structures: Day-ahead market and Intraday market. The day-ahead market is a forward market, in which hourly electricity prices are calculated for each hour of the next operating day based on today's data. The intraday market allows purchasing and selling of electricity throughout the whole day, up to a few minutes before the physical delivery. Rather than investigating day-ahead electricity prices, practitioners started to research intraday electrici-

ty prices and volumes (Uniejewski et al., 2019). The importance of forecast accuracy has drastically increased as it directly impacts cost reductions. Over time, electricity price and load forecasting have improved with advancements in the available technologies and accurate data. We reviewed these changes over time in methodologies used to forecast electricity price and load domains. This article contains the analysis of an extensive bibliometric study of the Scopus database.

Review methodology and data analysis

We found 17 review papers on Scopus which contain literature review, systematic literature review, overview and state-of-the-art review papers. The first step of the analysis we conducted defining the keyword structure (KS). Defining KS is the most crucial step in a systematic review as it defines the direction that the study takes (Perera et al., 2019; Weerasinghe et al., 2023). The structure of the KS three levels; electricity domain, forecasting domain, and the market structure based on the time. The forecasting domain of supply chain concepts of the industry include price and imbalance. The market structure of two markets; intraday market and day-ahead market. Then, the search result narrowed down to journal publications that are published in English, followed by narrowing down the search result based on the subject area. From initial results, inclusion keywords were used

Logic Gate	Levels	Code in Scopus
	Level 1	(TITLE-ABS-KEY (electric*)
AND		
	Level 2	TITLE-ABS-KEY (supply OR demand OR imbalance OR price OR forecast*)
AND		
	Level 3	TITLE-ABS-KEY (intraday OR day-ahead))
AND		
	Limited to	LIMIT-TO (LANGUAGE , "English")) AND (LIMIT-TO (SRCTYPE , "j")
AND		
	Excluding	EXCLUDE (SUBJAREA , "AGRI") OR EXCLUDE (SUBJAREA , "ARTS") OR EXCLUDE (SUBJAREA , "MEDI") OR EXCLUDE (SUBJAREA , "PSYC") OR EXCLUDE (SUBJAREA , "IMMU")

Figure 1: Keyword Structure

to recognize the most relevant studies to review. Studies that contain title or author keywords representing the identified words from both the forecasting contexts and electricity supply chain domain were selected in the first phase of selection.

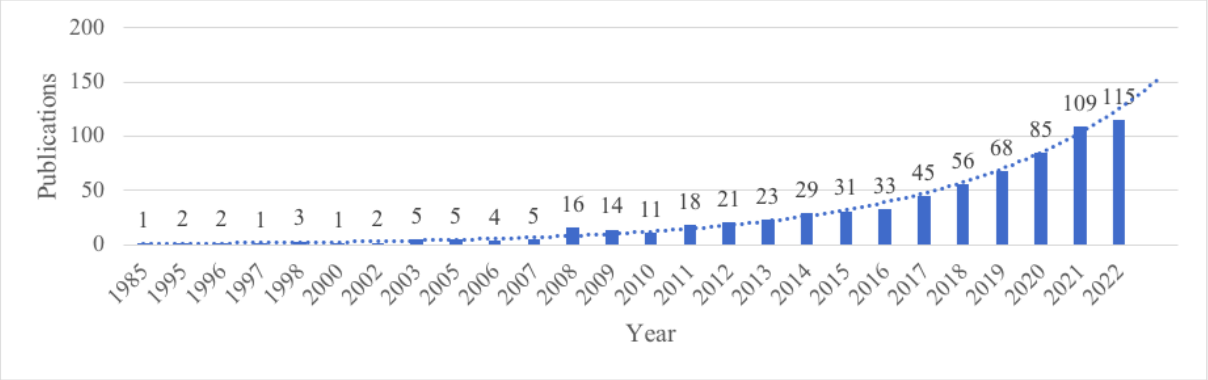

Figure 2: Number of publications over years

The inclusion keywords were searched within the abstracts. After filtering we manually selected 705 papers to be included by carefully going through their abstracts individually. We conducted a thorough bibliometric analysis on selected papers through two rounds of sorting.

Among selected studies, 53% were published after 2018. Energies, Applied Energy, IEEE Transactions on Power Systems are the journals which have the highest publications relevant to this scope. Researchers based in Europe and Asia have mostly conducted studies on this domain. We analyzed the methodologies used over time using author keywords includes methodologies.

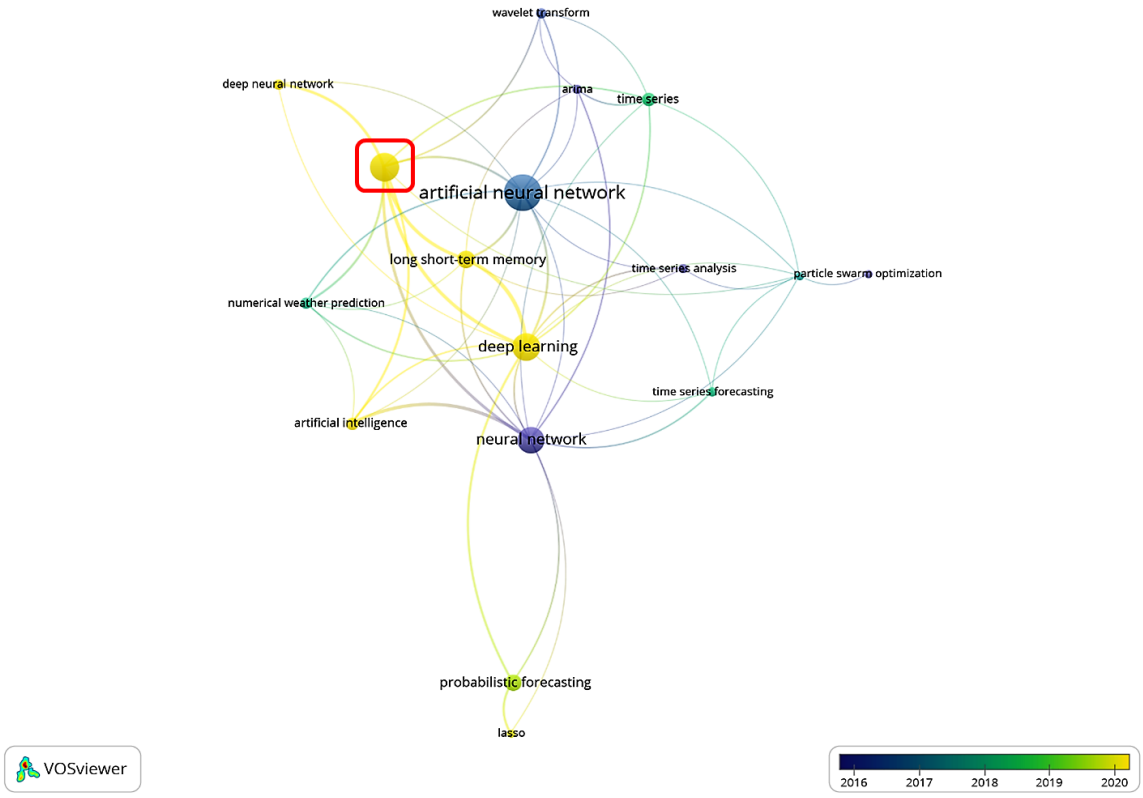

Figure 3: Research clusters in methodologies

The keyword analysis clearly shows that artificial neural network and machnine learning are the two key techniques used in this domain. Keywords include 6 clusters and over the time researchers have changed applied methodologies from artificial neural networks, and ARIMA models to machine learning and deep learning techniques. From this bibliographic analysis, we identified that artificial intelligence and deep learning algorithms are increasingly used in the electricity industry for forecasting since they can analyze large amounts of data and identify patterns that may be missed by traditional statistical methods. With the introduction of the smart grid technology researchers were able to access more accurate and reliable data for forecasting electricity demand and supply. Additionally, Internet of Things (IoT) technology is being used to collect real-time data from sensors installed in the electricity grid, which can help in predicting demand and supply with more accuracy specifically in the intraday market. These advanced forecasting models help to minimize forecast errors by considering many factors that affect energy demand and supply, including weather patterns, energy consumption patterns, and energy generation. These advancements in electricity forecasting have led to more accurate and reliable predictions of demand and supply, which can help utility providers to better plan and manage their resources, reduce costs, and improve grid stability.

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