In the wake of the 2008 financial tsunami, existing methods and tools for managing financial risks have been criticized for weaknesses in monitoring and alleviating risks at the systemic level. A 2009 article in *Nature* suggested new approaches to modeling economic meltdowns are needed to prevent future financial crises. However, existing studies have not focused on analysis of systemic risk at the individual bank level in a banking network, which is essential for monitoring and mitigating contagious bank failures. To this end, we develop a network approach to risk management (NARM) for modeling and analyzing systemic risk in banking systems. NARM views banks as a network that is linked through financial relationships. It incorporates network and financial principles into a business intelligence (BI) algorithm to analyze systemic risk attributed to each individual bank via simulations based on real-world data from the Federal Deposit Insurance Corporation. Our research demonstrates the feasibility of modeling and analyzing systemic risk at the individual bank level in a banking network using a BI-based approach. In terms of business impacts, NARM offers a new means for predicting contagious bank failures and determining capital injection priorities in the wake of financial crises. Our simulation study shows that under significant market shocks, the interbank payment relationship becomes more influential than the correlated bank portfolio relationship in determining an individual bank’s survival. These insights should help financial regulators devise more effective policies and mechanisms to prevent the collapse of a banking system. Further, NARM and the simulation procedure driven by real-world data proposed in this study have instructional value to similar research areas such as bank stress testing, where time series data and business networks may be studied.

**Keywords:** Systemic risk, contagious bank failures, business intelligence, simulation