STEVENS
INSTITUTE OF TECHNOLOGY
1870

Ph.D. DISSERTATION DEFENSE

Candidate:	Shiyu Yuan
Degree:	Doctor of Philosophy
School/Department:	**Charles V. Schaefer, Jr. School of Engineering and Science /Department of Systems Engineering**
Date:	**Apr. 24 2026**
Time/Location:	**2:00 pm EDT / Zoom** https://stevens.zoom.us/j/96031019183
Title:	**Learning Structural Dynamics in Document-Driven Temporal Knowledge Graphs: From Relation Forecasting to Centrality Evolution**
Chairperson:	**Dr. Carlo Lipizzi,** Department of Systems Engineering, School of Engineering & Sciences
Committee Members:	**Dr. Ali Yassine,** Department of Systems Engineering, School of Engineering & Sciences **Dr. Ying Wang,** Department of Systems Engineering, School of Engineering & Sciences **Dr. Michael Kowal,** School of Humanities, Arts and Social Science

ABSTRACT

Temporal forecasting from unstructured text remains a fundamental challenge in information systems, finance, and decision intelligence. While recent advances in natural language processing and temporal graph learning have enabled progress in event prediction and link forecasting, existing approaches largely operate at the level of local predictions and fail to capture the evolution of global system structure over time. This limitation is particularly pronounced in document-driven temporally evolving settings, where knowledge must be extracted from large-scale text corpora and aligned consistently across time.

This dissertation proposes an integrated framework for structure-aware temporal forecasting from unstructured text, centered on temporal knowledge graphs. First, a document-driven pipeline is developed to transform unstructured text into temporally aligned knowledge graphs through structured extraction, canonicalization, and feature construction. Second, the dissertation introduces forecasting approaches at both relational and structural levels, including graph-based temporal models for relation prediction and a dynamic PageRank operator that directly models the evolution of global centrality distributions. Third, a

structural evaluation paradigm based on centrality alignment is proposed to assess whether forecasted graphs preserve higher-order organization over time.

Empirical results on longitudinal corporate disclosures demonstrate that improvements in link-level prediction do not necessarily translate into accurate modeling of global graph structure. Structural evaluation based on centrality alignment reveals a partial decoupling between micro-level relational accuracy and macro-level organization. These findings motivate the need for structure-aware modeling and evaluation, suggesting that temporal forecasting from text can be viewed as a problem of structured system evolution and highlighting the importance of capturing global dynamics for long-horizon prediction.