## Research Philosophy

The digital universe will expand by 10 times from 4.4 trillion gigabytes in 2013 to 44 trillion in 2020 (Turner et al. 2014). This rapid growth has resulted in a phenomenon called “big data.” Big data is a “paradigm shift from hypothesis-driven to data-driven discovery” that allows to automatically extract “new knowledge about the physical, biological, and cyber world” (Wactlar 2012). Utilizing the big-data concept and techniques is crucial for the construction industry that involves collection and exchange of a large amount of data, but the industry is consistently lagging behind the data utilization (Cox et al. 2002; Holler et al. 2014; McKinsey Center for Business Technology 2012). A huge opportunity exists to transform the industry from hypothesis and experience-driven decision-making to fact and data-driven decision-making. My research investigates construction datasets including daily work report, bid, and project information; identifies the challenges for better collection of data; and develops methodologies to utilize those datasets in making vital construction management decisions such as cost estimation and schedule development. I have developed an enhanced framework to build a new daily work report system or improve existing ones that can support decisions throughout the life cycle of ongoing and future projects. I also developed an automated as-built schedule generation methodology from daily work report data to track construction project progress systematically. Furthermore, I have formulated a pattern-based as-planned schedule preparation method that utilizes the historical as-builts. This innovative pattern-based scheduling aids schedulers in preparing as-planned schedules more efficiently, reliably, and confidently.

I believe the innovative as-planned scheduling approach I have introduced is a major step toward the evolution of as-planned scheduling methods, which until now have been highly dependent on schedulers’ experience. My research will be a basis for automating the as-planned schedule development in advanced scheduling systems. Similarly, my automated as-built schedule development method enables state Departments of Transportation (DOTs) to monitor construction progress in real time and ease delay claim resolution. Productivity data from a daily work report system will be crucial for comparing the productivity variation in different site conditions, weather conditions, project types, and locations. It will be a knowledge base to extract appropriate production rates for future projects. This will tremendously improve in developing reliable schedules and completing projects on time without cost overruns associated with delays.

My future endeavor is focused on enhancing data collection methods and practices and increasing the active utilization for project life cycle decision-making. I would like to transform the construction industry to utilize autonomous systems. Construction activities are conducted in an uncontrolled environment, and hence it is challenging to simulate and automate construction data analysis. However, modern computers and advanced data mining techniques are capable of mimicking many aspects of human brains and can process virtually all available data to make decisions. This presents a huge opportunity, but there is lack of sufficient effort to change the condition. My research goal is to automate the construction data analysis to make decisions effectively, efficiently, reliably, accurately, and transparently.

To start my career as a faculty member, I plan to actively evaluate, select, and write proposals based on over two dozen proposal ideas I already have. I will look for inter and intra-departmental collaborators to bring my and collaborators’ ideas to the reality. I will work on establishing a research lab – “Data Mining for Construction Management” (DaMiCoM) – to mine construction data with state-of-the-art technologies. The laboratory will provide an environment for researchers and students to conduct advanced data mining techniques to various research. The results of research conducted in the lab will be disseminated through nationally and internationally distinguished journals and conferences such as *ASCE Journal of Construction Engineering and Management*, *Elsevier Automation in Construction*, *ASCE Journal of Computing in Civil Engineering*, *Transportation Research Board (TRB)*, *and Construction Research Records (CRC)*. I will also incorporate the research results in my graduate and undergraduate courses to equip students with recent knowledge generated in the construction industry.

To establish a successful research portfolio, I will pursue a number of national and state level funding agencies to fund data-mining oriented research in the construction industry. The National Science Foundation (NSF) funding opportunities for Computational and Data-Enabled Science and Engineering (CDS&E) and Civil Infrastructure Systems (CIS) as well as the National Corporative Highway Research Program’s (NCHRP) funding opportunity Innovations Deserving Exploratory Analysis (IDEA) will be used to fund innovative ideas. I will pursue other national and state level funding agencies such as state DOTs and Construction Industry Institute (CII) to fund applied research projects.

I have gained experience in all aspects of a research project: from writing research need statements and proposals to executing the project and writing the final report. I have arranged meetings with industry personnel and conducted the vetting process for a federal guidebook. I participated in multiple grant writing workshops to develop proposal-writing skills. I worked closely with my advisor Dr. David Jeong and my PhD committee member Dr. Douglas D. Gransberg and applied the skills I learned to write a successful research proposal of the amount $152,463. I have worked on research projects totaling over a million dollars during my graduate school as a lead and assistant student investigator.

I have taken multiple courses focused on data management and data analytics such as “knowledge discovery and data mining,” “software tools for large scale data analysis,” and “GIS programming and automation” to prepare my research career in the data-driven decision-making arena. My academic and industry experience on programming enables me to extract detailed data from existing systems for my research projects and to develop powerful data-mining models from the data. I believe not many construction engineering faculty have the data analytics and programming skills that I have.

**References**

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