UNITED STATES OFFICE OF PERSONNEL MANAGEMENT
Washington, DC 20415

The Director

April 29, 2024

Memorandum For Chief Executive Officer Councils

From: Kiran A. Ahuja
Director

Subject: Artificial Intelligence (AI) Competency Model for Civil Engineering, 0810

The U.S. Office of Personnel Management (OPM) is pleased to issue the Artificial Intelligence (AI) Competency Model for Civil Engineers, (GS-810 series). The guidance is in support of specific requirements of Executive Order 14110 on the Safe, Secure, and Trustworthy Development and Use of Artificial Intelligence (AI Executive Order). This model may also be used, if applicable, for other related occupations, for ensuring that adequate AI expertise and credentials in these occupations in the Federal Government reflect the increased use of AI in critical infrastructure. To fulfill these requirements, OPM conducted an occupational study on AI in civil engineering work. Additionally, this study supports agencies implementation of the Infrastructure Investment and Jobs Act (Bipartisan Infrastructure Law) by enhancing their capabilities to leverage AI to meet the requirements of the Act, which include rebuilding America's roads, bridges, and rails, expanding access to clean water, promoting access to high speed internet, addressing the climate crisis, and advancing environmental justice. This study also supports the use of skills-based hiring across the Federal Government. As a result of this study, OPM is pleased to issue the AI Competency Model for Civil Engineering, 0810.

In support of this effort, OPM consulted with subject matter experts (SMEs), to explore the impact and use of AI on civil engineering work, and the AI competencies needed to perform civil engineering work. As part of Public Law 116-260, AI in Government Act of 2020 (September 14, 2020), which requires OPM to issue regulations that identify key skills and competencies needed for AI work in an agency, OPM issued a government-wide survey to 0810 series, Civil Engineering employees and supervisors to

identify critical AI competencies needed to perform civil engineering work. The data collected from an environmental scan, meetings, and surveys were used to paint a comprehensive picture of the use of AI in civil engineering work throughout the Federal Government and to validate the AI Competency Model for Civil Engineering.

In addition to the competency model, we attached some use cases for AI in civil engineering work. During our stakeholder engagement activities with agencies and environmental scan, we identified example use cases for how civil engineers can use AI to perform their work. From these activities, we are sharing insights on how AI can impact civil engineering work. This document provides the impact of AI for each of the seven civil engineering parentheticals and their definitions as outlined in OPM's Job Family Position Classification Standard for Professional Work in the Engineering and Architecture Group, Civil Engineering 0810. For information on the use of AI in the Federal Government, please refer to the Artificial Intelligence Classification Policy and Talent Acquisition Guidance. The AI Competency Model for Civil Engineering, 0810 may be used in such agency efforts as workforce planning, training and development, performance management, recruitment, and selection. Through job analysis (5 CFR § 300.103), agencies must determine the applicability of these competencies to positions within their agency. Please refer to OPM's Delegated Examining Operations Handbook for more information on conducting a job analysis.

The competencies identified in this model may be used by agencies for their Civil Engineering positions that use AI technology to perform work. The competency model includes the following:

- the AI civil engineering competencies,
- the AI civil engineering general and technical competencies for each applicable grade level,
- the AI civil engineering competency importance rankings, and
- the AI civil engineering general and technical competency definitions.

OPM will continue to support agency efforts through the implementation of the guidance in this issuance. If you have any questions regarding the competency model, please contact Classification and Assessment Policy at competency@opm.gov.

Attachments (see below): Artificial Intelligence Competency Model for Civil Engineering, 0810, Use Cases for Artificial Intelligence in Civil Engineering Work

cc: Deputy Chief Human Capital Officers (CHCOs), Human Resources Directors, Chief Artificial Intelligence Officers (CAIOs)

Artificial Intelligence (AI) Competency Model for Civil Engineering, 0810

U.S. Office of Personnel Management

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AI Civil Engineer Competencies

The table below presents the 26 general competencies and 3 technical competencies found to be important for performing AI civil engineering work. Through job analysis (5 CFR § 300.103), agencies must determine the applicability of these competencies to positions within their agency. Please refer to OPM's Delegated Examining Operations Handbook for more information on conducting a job analysis.

General Competencies

- Accountability
- Attention to Detail
- Computer Skills
- Decisiveness
- Information Management
- Integrity/Honesty
- Interpersonal Skills
- Learning
- Mathematical Reasoning
- Mental Visualization
- Oral Communication
- Perceptual Speed
- Problem Solving
- Project Management
- Reading
- Reading Comprehension
- Reasoning
- Resilience
- Self-Management
- Strategic Thinking
- Stress Tolerance
- Teamwork
- Technical Competence
- Technical Application
- Technology Awareness
- Written Communication

Technical Competencies

- Data Analysis
- Design
- Mathematics and Statistics

AI Civil Engineer General Competencies by Grade

The following tables list the general competencies that have been confirmed as appropriate for employee selection on a Government-wide basis for AI civil engineering work at the grades indicated. Note: No competencies were confirmed as appropriate for selection for GS-09 and GS-12.

General Competencies

Competency	GS-11	GS-13
Accountability		X
Attention to Detail	X	X
Computer Skills		X
Decisiveness	X	
Design	X	X
Information Management		X
Integrity/Honesty	X	X
Interpersonal Skills	X	X
Learning	X	
Mathematical Reasoning	X	
Perceptual Speed	X	
Problem Solving	X	X
Project Management	X	X
Reading	X	X
Reading Comprehension	X	X
Reasoning	X	
Self-Management		X
Strategic Thinking		X
Stress Tolerance	X	
Teamwork	X	X
Technical Competence	X	X
Technical Application		X
Technology Awareness	X	X
Written Communication	X	X

AI Civil Engineer Technical Competencies by Grade

The following tables list the technical competencies that have been confirmed as appropriate for employee selection on a Government-wide basis for AI civil engineering work at the grades indicated. Note: No competencies were confirmed as appropriate for selection for grade levels GS-09, GS-12, and GS-13.

Technical Competencies

Competency	GS-11
Data Analysis	X
Mathematics and Statistics	X

AI Civil Engineer Competency Importance Ranking

As the maturity level of AI skills continues to evolve and becomes more prevalent in the field of civil engineering, certain general and technical competencies may become more or less important within the next three years to perform civil engineering work with ongoing advancements and innovations shaping the work. Some specific examples of AI applications in civil engineer anticipated may include predictive maintenance for infrastructure, design optimization, and traffic management system. The lists below present the rank order of the general and technical competencies for AI civil engineering work on current importance and future importance in three years based on supervisor and employee ratings. Note: Cells designated with NR stands for Not Ranked.

Competencies

Competency	Current Importance	Future Importance
Technical Competence	1	1
Reading Comprehension	2	2
Teamwork	3	3
Written Communication	4	NR
Reading	5	4
Integrity/Honesty	6	8
Attention to Detail	7	6
Accountability	8	5
Interpersonal Skills	9	7
Learning	10	10
Problem Solving	11	9
Self-Management	12	18
Information Management	13	14
Reasoning	14	17
Technology Awareness	15	15
Technology Application	NR	11
Mathematical Reasoning	NR	12
Project Management	NR	13
Technology Awareness	NR	15
Decisiveness	NR	16

Competency	Current Importance	Future Importance
Oral Communication	NR	19
Mathematics and Statistics	NR	20
Design	NR	21
Mental Visualization	NR	22
Resilience	NR	23
Computer Skills	NR	24
Perceptual Speed	NR	25

AI Competency Model for Civil Engineering, 0810 General Competency Definitions

This section presents definitions for the general and technical competencies found within the AI Competency Model for Civil Engineering, 0810.

Definitions of General Competencies

Competency	Definition
Accountability	Holds self and others accountable for measurable high-quality, timely, equitable and cost-effective results. Determines objectives, sets priorities, and does and delegates' work. Accepts responsibility for mistakes. Complies with established control systems and rules.
Attention to Detail	Is thorough when performing work and conscientious about attending to detail and potential biases.
Computer Skills	Uses computers, software applications, databases, and automated systems to accomplish work.
Decisiveness	Makes well-informed, effective, and timely decisions, balancing speed, and thoughtfulness; perceives the impact and implications of decisions and takes decisive and early steps to mitigate negative impacts.
Information Management	Identifies a need for and knows where or how to gather information; organizes and maintains information or information management systems.
Integrity/Honesty	Behaves in an honest, fair, and ethical manner. Shows consistency in words and actions. Models' high standards of ethics.
Interpersonal Skills	Treats others with courtesy, sensitivity, and respect. Considers and responds appropriately to the needs and feelings of different people in different situations.
Learning	Uses efficient learning techniques to acquire and apply new knowledge and skills; uses training, feedback, or other opportunities for self-learning and development.

Competency	Definition
Mathematical Reasoning	Solves practical problems by choosing appropriately from a variety of mathematical and statistical techniques.
Mental Visualization	Sees things in the mind by mentally organizing and processing symbols, pictures, graphs, objects, or other information (for example, sees a building from a blueprint, or sees the flow of work activities from reading a work plan).
Oral Communication	Makes clear and convincing oral presentations. Listens effectively; clarifies information as needed. Effectively communicates technical information to non-technical audiences and stakeholders.
Perceptual Speed	Quickly and accurately sees detail in words, numbers, pictures, and graphs.
Problem Solving	Identifies and analyzes problems; weighs relevance and accuracy of information; generates and evaluates alternative solutions; makes recommendations.
Project Management	Knowledge of the principles, methods, or tools for developing, scheduling, coordinating, and managing projects and resources, including monitoring, and inspecting costs, work, and contractor performance.
Reading	Understands and interprets written material, including technical material, rules, regulations, instructions, reports, charts, graphs, or tables; applies what is learned from written material to specific situations.
Reading Comprehension	Understands and interprets written material, including technical material, rules, regulations, instructions, reports, charts, graphs, or tables; applies what is learned from written material to specific situations.
Reasoning	Identifies rules, principles, or relationships that explain facts, data, or other information; analyzes information and makes correct inferences or draws accurate conclusions.

Competency	Definition
Resilience	Deals effectively with pressure; remains optimistic and persistent, even under adversity. Recovers quickly from setbacks.
Self-Management	Sets well-defined and realistic personal goals; displays a high level of initiative, effort, and commitment towards completing assignments in a timely manner; works with minimal supervision; is motivated to achieve; demonstrates responsible behavior.
Strategic Thinking	Formulates objectives and priorities and implements plans consistent with the long-term interests of the organization in a global environment. Capitalizes on opportunities and mitigates risks.
Stress Tolerance	Deals calmly and effectively with high stress situations (for example, tight deadlines, hostile individuals, emergency situations, dangerous situations).
Teamwork	Encourages and facilitates cooperation, pride, trust, and group identity; fosters commitment and team spirit; works with others to achieve goals.
Technical Competence	Uses knowledge that is acquired through formal training or extensive on-the-job experience to perform one's job; works with, understands, and evaluates technical information related to the job; advises others on technical issues.
Technical Application	Uses machines, tools, instruments, or equipment effectively; uses computers and computer applications to analyze and communicate information in the appropriate format.
Technology Awareness	Knowledge of developments and new applications of information technology (hardware, software, telecommunications), emerging technologies and their applications to business processes, how emerging

Competency	Definition
	technologies can impact people's rights and safety, and applications and implementation of information systems to meet organizational requirements.
Written Communication	Writes in a clear, concise, organized, and convincing manner for the intended audience. Effectively communicates technical information to non-technical audiences and stakeholders.

Definitions of Technical Competencies

Competency	Definition
Data Analysis	Manipulates and exploits internal and external, structured, and unstructured data sources to accomplish organizational goals.
Design	Knowledge of conceptualizing, developing, producing, understanding, and using plans, models, blueprints, and maps, including the use of tools and instruments to produce precision technical drawings, working prototypes, components, or systems.
Mathematics and Statistics	Utilizes an understanding of mathematical and statistical techniques and/or software tools to apply appropriate statistical or mathematical methodology to datasets in order derive meaning, determine significance, or to produce metrics.

Attachment: Use Cases for Artificial Intelligence (AI) in Civil Engineering Work

Artificial Intelligence (AI) is beginning to revolutionize many aspects of civil engineering work, including design, construction, maintenance, and management of infrastructure. During our stakeholder engagement activities with agencies and environmental scan, we identified example use cases for how civil engineers can use AI to perform their work. From these activities, we are sharing insights on how AI can impact civil engineer work. The table below shows some examples of how AI impacts civil engineering specialty areas that are identified in OPM's Job Family Position Classification Standard for Professional Work in the Engineering and Architecture Group, 0800.

Specialty Area	Definition	Impact of AI
Construction Management	Work primarily involving the performance and/or oversight of onsite construction work, including inspection and acceptance of facility or utility construction work performed by a contractor.	AI is used to generate project plans, site layout modeling, predict the estimation cost of the project, improve the critical path, labor productivity, to prevent the collapse of scaffolding structures and estimation of completion of the project.[1]
Geotechnical	Work primarily involving: • evaluation of soil, rock properties, slope stability, and seepage; • seismic analysis of soil, rock properties, and sub-surfaces; and • evaluation and design of earth retaining systems, embankment dams, structure	"AI models process data from various sources, including satellite imagery and ground surveys, to predict soil stability, liquefaction potential, and other crucial factors in construction." [2]

[1] Kumar, A., Mor, N. (2021). An Approach-Driven: Use of Artificial Intelligence and Its Applications in Civil Engineering. In: Manoharan, K.G., Nehru, J.A., Balasubramanian, S. (eds) Artificial Intelligence and IoT. Studies in Big Data, (pp. 201-221). Springer. https://doi.org/10.1007/978-981-33-6400-4_10

[2] AI in Civil Engineering: The Prominent Role of AI in AEC in 2024. (2024, January 26). Hyscaler. https://hyscaler.com/insights/ai-in-civil-engineering//

Specialty Area	Definition	Impact of AI
	foundations, and ground improvement projects.	
Highway	Work primarily involving the design and construction of highways, road structures, and highway systems considering factors such as economics, route location, traffic behavior, and vehicle characteristics.	AI applications perform "predictive maintenance, where AI algorithms forecast the need for repairs before issues become critical, to environmental monitoring, assessing and mitigating the impact of highway traffic on the environment." [3]
Hydraulic	Work primarily involving the application of hydraulics and principles of fluid mechanics.	"AI enables engineers to optimize water management systems, predict potential failures, and make informed decisions about infrastructure development and maintenance." [4]
Hydrologic	Work primarily involving applying the science of hydrology, including: • analyzing flow characteristics; • designing drainage structures (e.g., bridges and culverts); and • evaluating facility (e.g., reservoirs, canals, pipelines, pumping plants) capacities and operation.	Al models are "utilized for prediction of water variables: rainfall-runoff, evaporation and evapotranspiration, streamflow, sediment, dam or lake water levels and water quality variables. AI methods have been successfully used to predict sediment in width section of a river, evaporation and evapotranspiration, rainfall-

[3] Longinos, MJ, & Widlund, J. (2024, February 28). How can I use AI for highways engineering? Civils.ai. https://civils.ai/blog/ai-for-highways-engineering

[4] Worldwide Hydraulic Professionals. (2023, July 26). How AI is Paving the Way for Next-Generation Hydraulic Engineering Solutions. https://whyps.com/how-ai-is-paving-the-way-for-next-generation-hydraulic-engineering-solutions

Specialty Area	Definition	Impact of AI
		runoff, streamflow, water quality variables and modelling of dam or lake water levels." [5]
Structural	Work primarily involving the application of structural dynamics theories, including the distribution of loads, stresses resulting from loads, and strength of materials, such as for the design or construction of structures, bridge and tunnel design and construction, seismic analysis of structures, and inspection and condition rating of bridges.	"AI algorithms that can process and analyze vast datasets, these tools offer optimized structural designs that balance strength, efficiency, and cost-effectiveness. AI, can propose multiple design solutions based on specific criteria set by engineers, such as material types, geometric constraints, and load requirements." [6]
Transportation	Work primarily involving the planning and/or design of transportation systems including traffic engineering, route systems and modeling, and sensor systems, processes, and technology.	"AI systems can analyze vast amounts of traffic data to optimize signal timings, reduce traffic congestion, and enhance public transportation routes. AI algorithms can predict traffic patterns and suggest alterations to traffic flow, reducing commute times and vehicle emissions." [7]

The above examples illustrate how AI applications can enhance work by complementing civil engineering expertise. The deployment of AI technologies for routine and repetitive tasks grants civil engineers the freedom to channel their specialized skills toward more significant, value-driven tasks that align with the

[5] Ay, M. & Özyıldırım, S. (2018). Artificial Intelligence (AI) Studies in Water Resources. Natural and Engineering Sciences. 3(2), 187-195. https://doi.org/10.28978/nesciences.424674

[6] Longinos, MJ, & Widlund, J. (2024, February 28). How can I use AI for highways engineering? Civils.ai. https://civils.ai/blog/ai-for-highways-engineering

[7] AI in Civil Engineering: The Prominent Role of AI in AEC in 2024. (2024, January 26). Hyscaler. https://hyscaler.com/insights/ai-in-civil-engineering//

objectives and strategic ambitions of their organizations. By equipping civil engineers with sophisticated tools and resources necessary for routine tasks, AI helps to increase productivity, thereby empowering engineers to focus on complex, technical endeavors that demand their professional acumen.

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