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Developing the Next Generation of Science Data System Engineers

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Duties/Skills

Knowledge

Very often our candidates have been contractors

Career Path at NASA/GSFC

Engineer

- Works in-depth on a data system component development or operation
- Serves with specific science or instrument team
- Offers cross-training in science and computer technologies

- **Looking for degrees in the following areas:**
  - **Physical Sciences**
    - **Astronomy, Astrophysics**
    - **Geology**
    - **Hydrology**
    - **Meteorology**
    - **Oceanography**
    - **Physics**
  - **Computer Engineering**
  - **Computer Science**
- **But the following fields of expertise are also useful:**
  - **Remote Sensing**
  - **Mathematics**
  - **Physical geography**
  - **Human geography**

Journeyman Engineer

- Develops and operates specific components of an instrument data system
- Integrates and tests instrument algorithms
- Manages mission science data collections
- Participates in professional societies
- Works on collaborative US agency programs

- **Thorough knowledge of:**
  - **Science Data structures**
  - **Programming languages**
  - **Operating systems**
  - **Applications techniques**
  - **Service oriented architectures**
  - **Off-the-shelf and opens source software (e.g., RDMS, GIS)**
  - **Hardware systems**
- **Knows science and engineering concepts, practices:**
  - **Levels of processed data (0, 1, 2…)**
  - **Orbital mechanics, instruments**
  - **Map projections (Lat/lon, RA/DEC)**
  - **Instrument calibration techniques/algorithms**
  - **Validation techniques**
  - **Physical science algorithms, modeling systems, Geographic Information Systems**
  - **Standard data formats (CCSDS, HDF, CDF, FITs)**
- **Knows how to integrate new technologies into current systems**

Senior Engineer

- Leads technical activities of inter-disciplinary engineers developing an instrument or data system component
- Oversees data center development, tracts costs and schedule, technical constraints
- Leads standards development efforts
- Serves as instructor on data management
- Serves as NASA representative to other US Agencies
- Participates in International projects

- **Thorough knowledge of software engineering design and development methodologies, paradigms, tools**
- **Sufficient to conceive, apply experimental theories to resolve unique or novel problems, significantly alter standard practices**
- **Knows agency information processing standards and policies**
- **Knows software engineering lifecycle**
- **Focus on particular domain to become expert**
  - **Software data storage**
  - **Science Data formats**
  - **Science metadata**
- **Data Management Expert**
- **Has experience with NASA science data and understand provenance issues, data quality**

Principal Engineer

- Oversees development for a mission or multi-mission science data system
- Plans and administers projects of national or international importance
- Establishes long-range agendas for development of large new unusually complex systems
- Responsible for resource requirements, policies, procedures and budgets
- Leads International projects

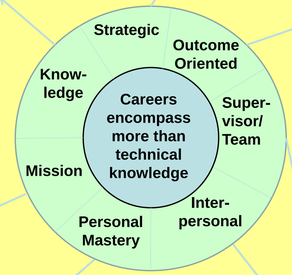
- **Thorough knowledge of:**
  - **Software engineering design and development methodologies**
  - **Agency information processing policies and standards**
  - **Science data system architectures, science data storage, data formats, science metadata**
- **Recognized Subject Matter Expert**
  - **Science Domain**
  - **Data Center systems and operations**
  - **Data Management**
  - **Data Manipulation and Services**
- **Extensive understanding of instrument and physical science discipline data formats, analytical methods, computations science**
- **Extends discipline knowledge boundary**
- **Project Management expertise**

Pathways and Perspectives

- **Instrument Software Data Systems**
- **Flight & Ground Data Systems**
- **Systems Engineering**
- **Data & Information Management**
- **Systems Thinking**
- **Integration**
- **Collaboration**

- **Strategic vision**
- **Change Management**
- **Risk Management**
- **External Awareness**

- **Customer Orientation**
- **Decisiveness**
- **Problem Solving**
- **Quality Principles**
- **Resource Management & Stewardship**
- **Technology Management**
- **Creativity & Innovation**
- **Results Orientation**
- **Process Oriented Management**
- **Program Development, Planning & Evaluation**



- **Mission & Organization Awareness**
- **Goals, Strategy & Policy**
- **Software Standards Adherence e.g. CMMI**
- **Discipline Standards Awareness e.g. CCSDS, ISO19115, HDF**

- **Coaching/Counseling/Mentoring**
- **Team Building**
- **Conflict Management**
- **Human Resources Management**
- **Diversity Awareness**
- **Situational Leadership**

- **Self-direction**
- **Reasoning**
- **Resilience**
- **Flexibility**
- **Ethics/Professionalism**
- **Honesty/Loyalty**
- **Continual Learning**
- **Attention to Detail**
- **Technical Competence**
- **Core Values**
- **Self-Esteem**

- **Interpersonal skills**
- **Oral/Written Communication**
- **Influencing/Negotiating**
- **Partnering/Teaming**
- **Political Savvy**
- **Presentation/Marketing Skills**
- **Organizational Representation & Liaison**
- **Working within a Team**

Science Data System Challenges

- **Architect smarter, flexible and scalable data systems:**
  - **Simplify components with common science data processing functions to ease evolution with emerging technology while maintaining connectivity with archival science data.**
  - **Standardized public data access interfaces of central & distributed sources.**
- **Increase science findings and practical applications by enabling cross-discipline use of science data.**
- **Standardize the fundamentally required content and structure:**
  - **Common depiction of time, location and accuracy.**
  - **Increasing complex remotes sensors and in-situ sensors from spacecraft, aircraft and surface networks.**
  - **Encompass data complexities of research and application discipline communities.**

Data System Engineer Challenges

- **Play an increasing role in developing metadata and data products.**
- **Adapt data processing and integration of science algorithms to an evolving computer industry.**
  - **Depicting discipline specific attributes for multiple types of observational data**
  - **Utilize attributes that can become common across science disciplines and observation systems**
- **Working with increasingly complex science data, multiple datasets and diverse sources requires a skilled workforce**
- **Take technical training focused in data science and new technologies**
- **Develop next generation science data systems that can serve multiple science disciplines, diverse observational data and model output.**

Career Track Guidance

Suggestions on how to find a career path:

- **Develop a long-term vision with a short term plan.**
- **Review your career plan annually.**
- **Listen to what others have done. Find a mentor, be a mentor.**
- **Improve your skills through continuing education.**
- **Challenge yourself, don't be afraid to change, be willing to take a risk.**

Seek out a career path that fits your goals and will be most satisfying to you:

- **Your individual interests, skills, and training will dictate the path you should follow.**
- **Over time, modify your path based on personal interests, values, goals, experiences, and new opportunities that present themselves.**