LA-UR-21-20140
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Title: Implementation Plan for NSE-wide-deployment of GRANTA Materials Intelligence: Proposed 4-year plan, plus capability support

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Intended for: Communication with software vendor

Issued: 2021-01-07

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Implementation Plan for NSE-wide-deployment of GRANTA Materials Intelligence

Proposed 4-year plan, plus capability support

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Managed by Triad National Security, LLC for the U.S. Department of Energy's NNSA

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- Mission Needs
- Essential Functionality
- Structure of Implementation

This talk in one slide: 4 sub-projects (Epics) will implement GRANTA MI over 3 years (phases), delivering essential functionality to support mission needs

Epics	Stories	Major Deliverables		
		Phase 1 (FY22)	**Phase 2 (FY23)**	**Phase 3 (FY24-25)**
System Infrastructure	Server implementation	• Hardware • Test Suite	• Process for license and usage monitoring	• Maintenance
	Authentication method	• OAuth2 tested and implemented		
Database Creation and Population	Principal database development	• Data schema designed	• Tools and workflows for uploading data developed	• Upload tools and workflows tested and implemented
	Principal database population		• Catalog legacy data for upload	• Legacy data uploaded • Data moved to shared servers
Application Configuration and Integration	Application configuration	• Core applications available • System-level homepages configured	• All applications available • All interfaces configured	• Maintenance
	Application integration	• Creo and Python integration testing • Config. For reference db	• Creo and Python integration deployed • Configuration for all db	
Training and Documentation	Training	• SMEs for database development trained	• Data generators trained	• (Periodic training for new users)
	Documentation	• Documentation of reference database usage	• Reference documentation for data generators	• Documentation of principal databases • Maintenance

Mission Needs

User Roles

Essential Functionality Supporting Mission Needs:

- Searching and reporting
- Customized interfaces
- Integration with NSE tools
- Tools for uploading data
- Access Control configuration tools
- Data schema configuration tools
- Legacy data available
- Documentation

Mission Needs

Mission Needs

Many aspects of the NSE mission to provide a credible nuclear deterrent require materials data management, including:

- **Modeling and simulation**:
  - To ensure material models are calibrated to trusted experimental data sets
  - To provide data for uncertainty quantification
- **Component qualification**:
  - To provide qualification evidence for new parts using both new and aged materials behavior
  - To ensure expensive test data is not lost
- **Production**:
  - To accept lots of parts and raw materials.
  - As a baseline for surveillance and as data for calibrating material models
- **Surveillance**:
  - As an indicator that the functionality of the weapon may have changed
  - As a source of materials aging data
- **Additive Manufacturing (AM)**:
  - To understand the complex relationships between AM build parameters and final material properties.
  - To (possibly) provide evidence for AM part certification.
- **At-risk materials**:
  - To identify materials availability issues before they affect production schedules

NSE needs a single source of trusted materials information

Essential Functionality

Essential functionality is derived from use-cases of specific roles that support the mission

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GRANTA MI will be configured to address the needs of the following user roles:

- **Data Generator (write user):**
  - E.g. a technologist generating material test data.
- **Engineering Analyst (read user):**
  - Performs simulations of weapon systems subjected to Stockpile-to-Target Sequence (STS) loads.
- **Engineering Designer (read user):**
  - Translates materials and geometry information from physicists, materials scientists, and product engineers into product definition.
- **Product Engineer (read user):**
  - Responsible for ensuring that new and existing parts and/or test assemblies meet their requirements.
- **Manufacturing Engineer (read user):**
  - Uses the product definition information provided by the design engineer to manufacture a physical part.
- **Material Scientist (read user):**
  - Provides critical materials knowledge to support many other roles.
- **Funding Manager (read user):**
  - Provides the funding necessary to create the materials expertise that supports the stockpile.
- **Material Model Developer (read user):**
  - Use material test data and knowledge of the mechanisms controlling material behavior to develop equations that are calibrated to specific materials and used in engineering analysis simulations.
- **Assessors (read user):**
  - Assess technical aspects of weapon systems, and this may include assessment of materials-related information.
- **Various support roles (e.g. Database Administrator, Server Administrator)**

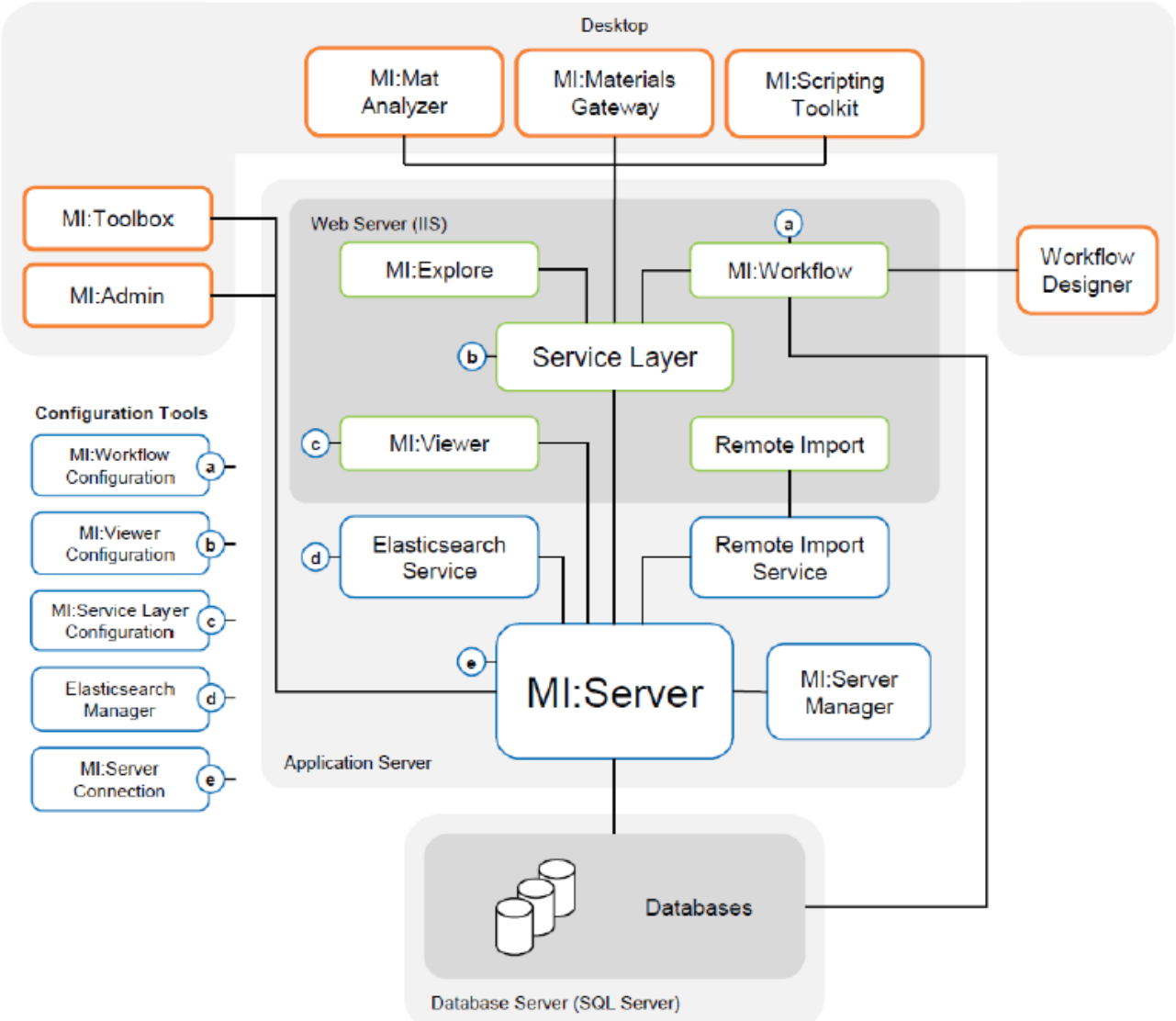
Many people use materials data, and they require specific functionality

Essential functionality is required for users to meet mission needs

- **Essential Functionality:**
  - **Searching and reporting**:
    - Users must be provided basic tools for searching, reporting, plotting, and comparison of data.
    - It must also be possible to extract this data from GRANTA MI into a neutral format.
  - **Customized interfaces**:
    - Different user roles will be provided different views into the databases so that they can easily find the data they need.
  - **Integration with NSE tools**:
    - Computer Aided Design (CAD) software; e.g. Creo Parametric
    - Product Lifecycle Management (PLM) software; e.g. Windchill/PDMLink
    - Computer Aided Engineering (CAE) software; e.g. Sierra, Paradyn, Abaqus, Ansys, etc
    - Software development tools; e.g. Python
  - **Tools for uploading data**:
    - Both web-based and local client tools need to be configured to work with NSE authentication.
  - **Access Control configuration tools**:
    - Tools for mapping user groups to permissions need to be available to some users.
  - **Data schema configuration tools**:
    - Tools for configuring schema need to be available to some users.
  - **Legacy data available**:
    - Some minimum set of legacy NSE materials data must exist in GRANTA MI and be available across sites for the implementation to be useful.
  - **Documentation**:
    - For ensuring consistent usage across all NSE sites, documentation of GRANTA MI usage relevant to each users' role needs to be readily available.

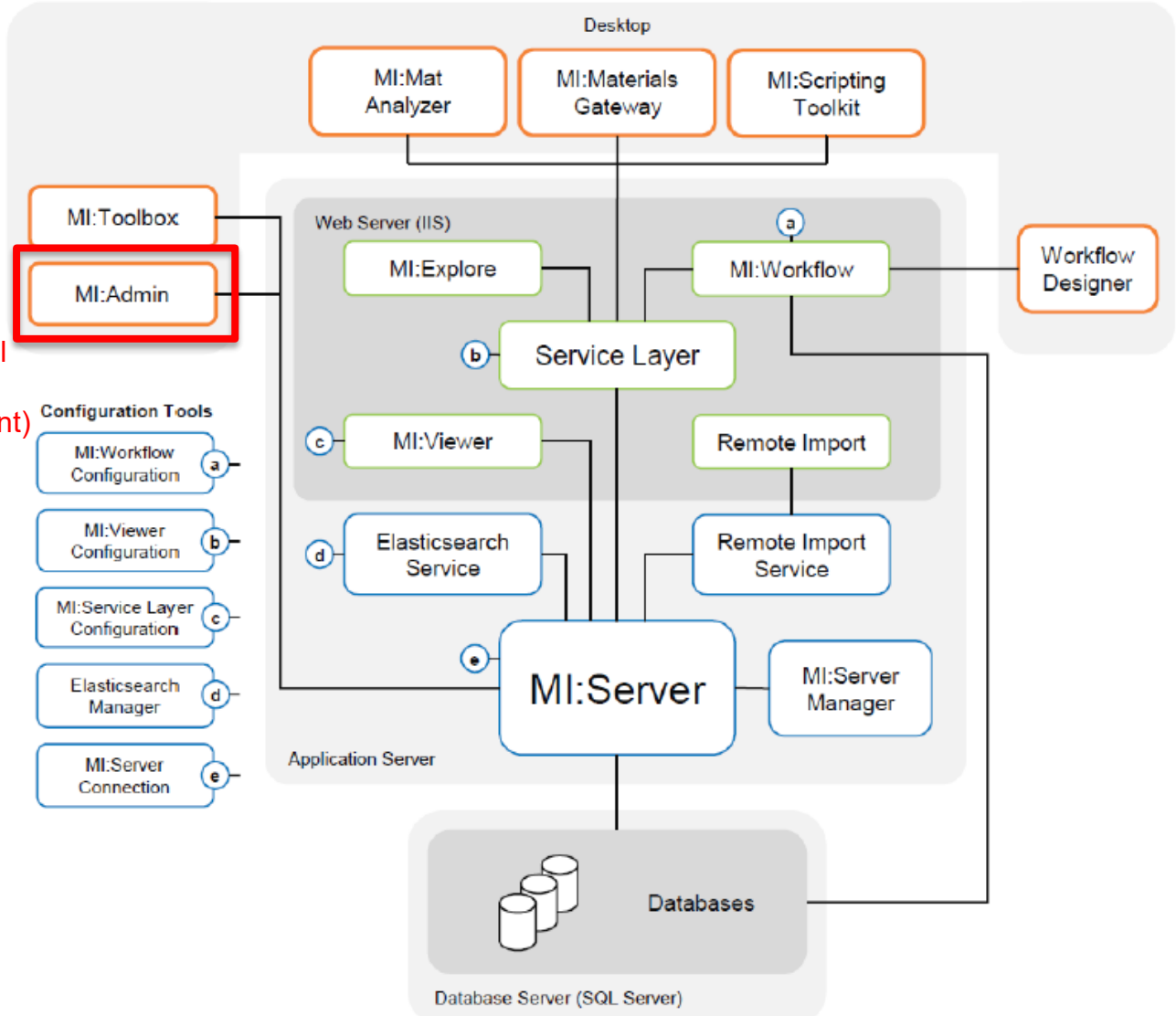
Full Operational Capability (FOC) is achieved when essential functionality is delivered

GRANTA MI provides this functionality with several components and integration capabilities



GRANTA MI provides this functionality with several components and integration capabilities

Data and access control configuration tool (local client)



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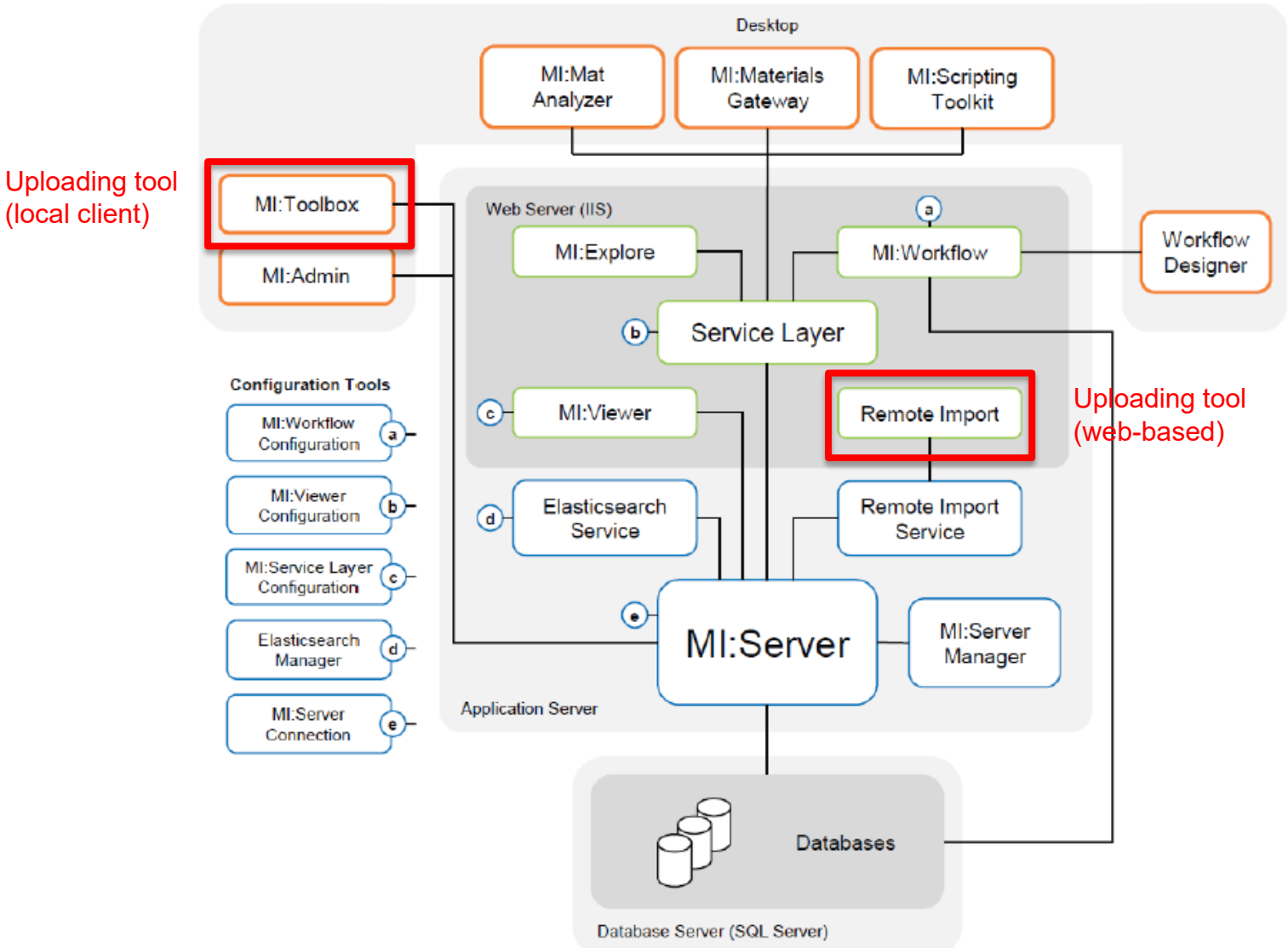
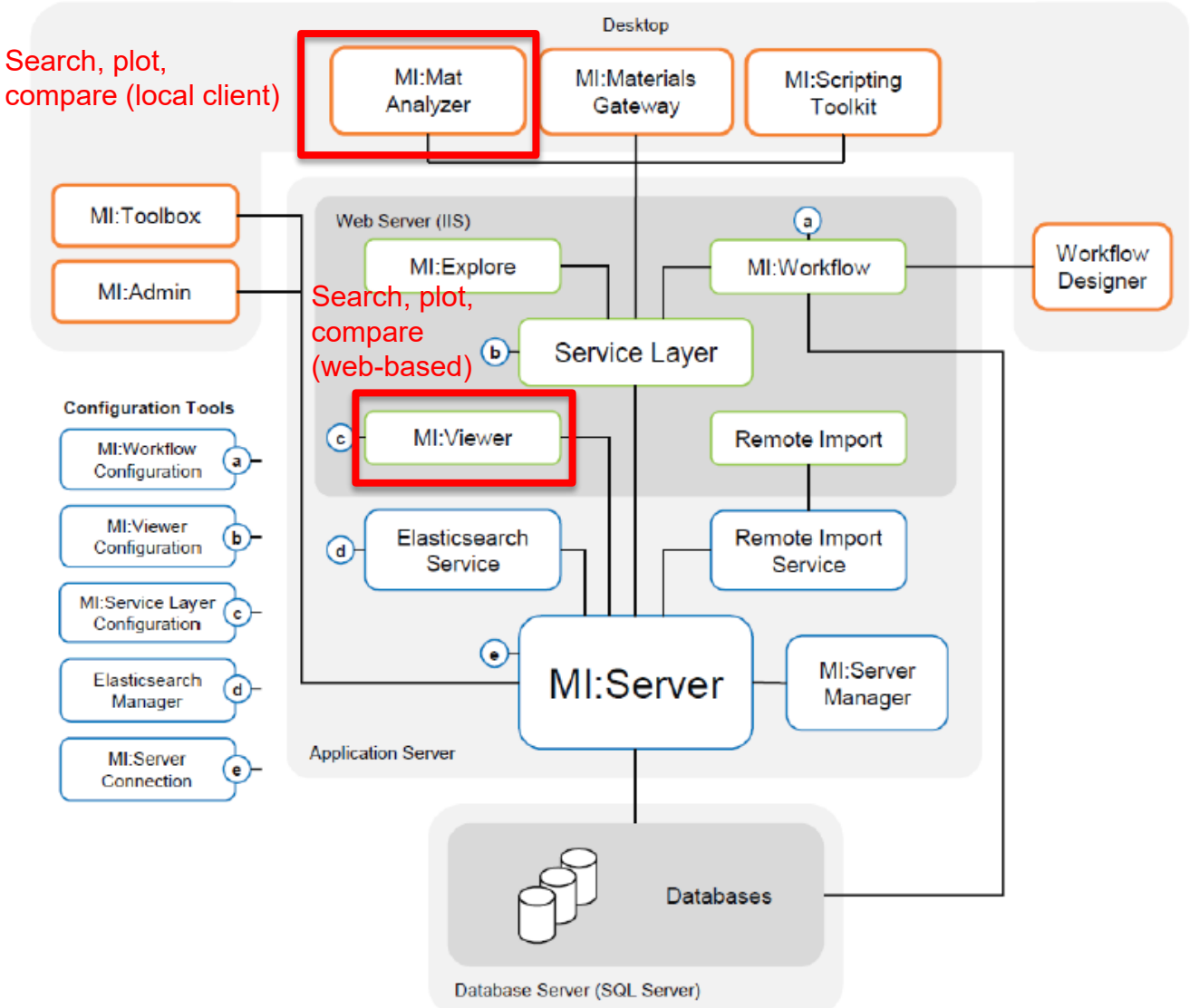


GRANTA MI provides most functionality with several components and integration capabilities



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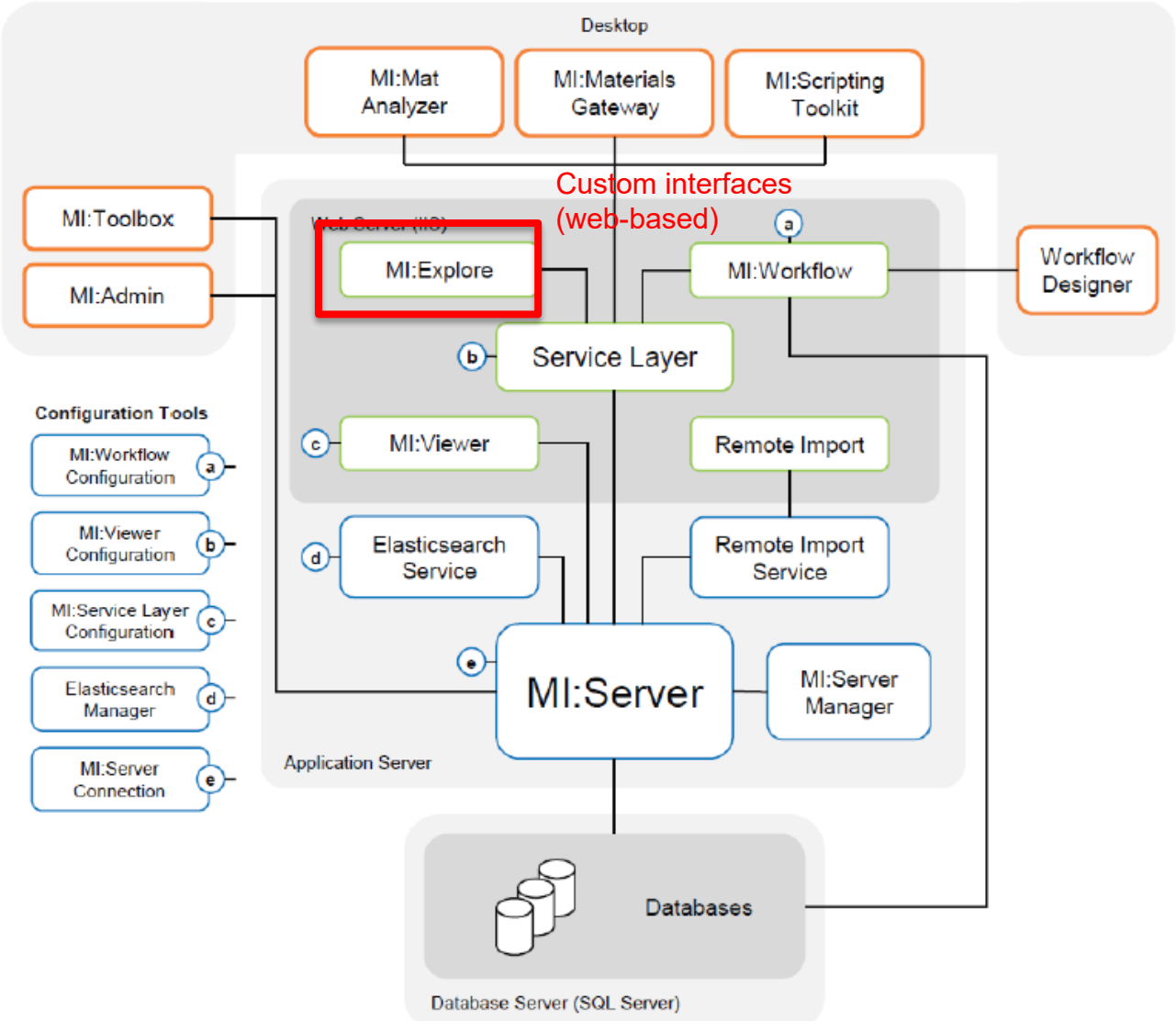

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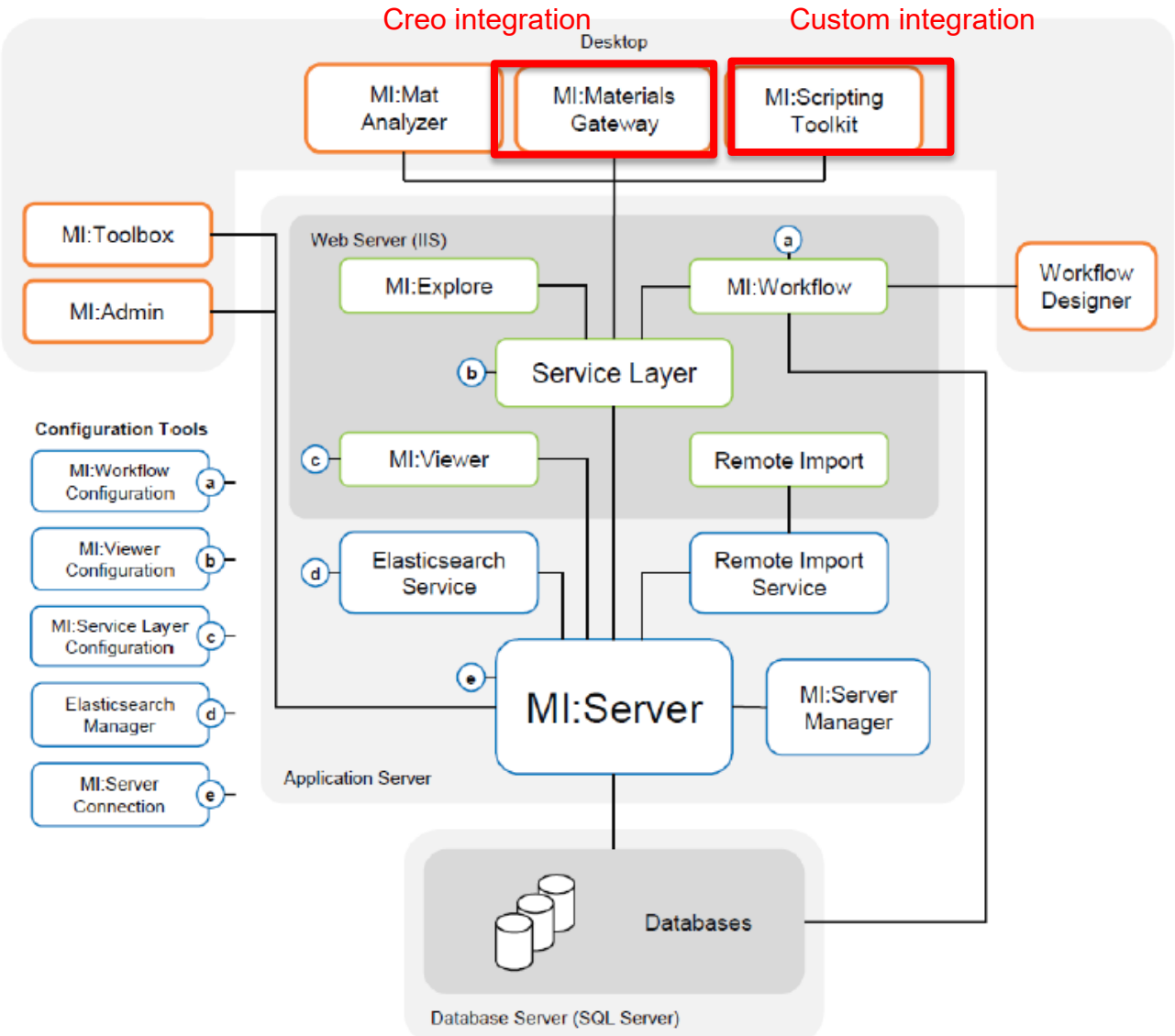
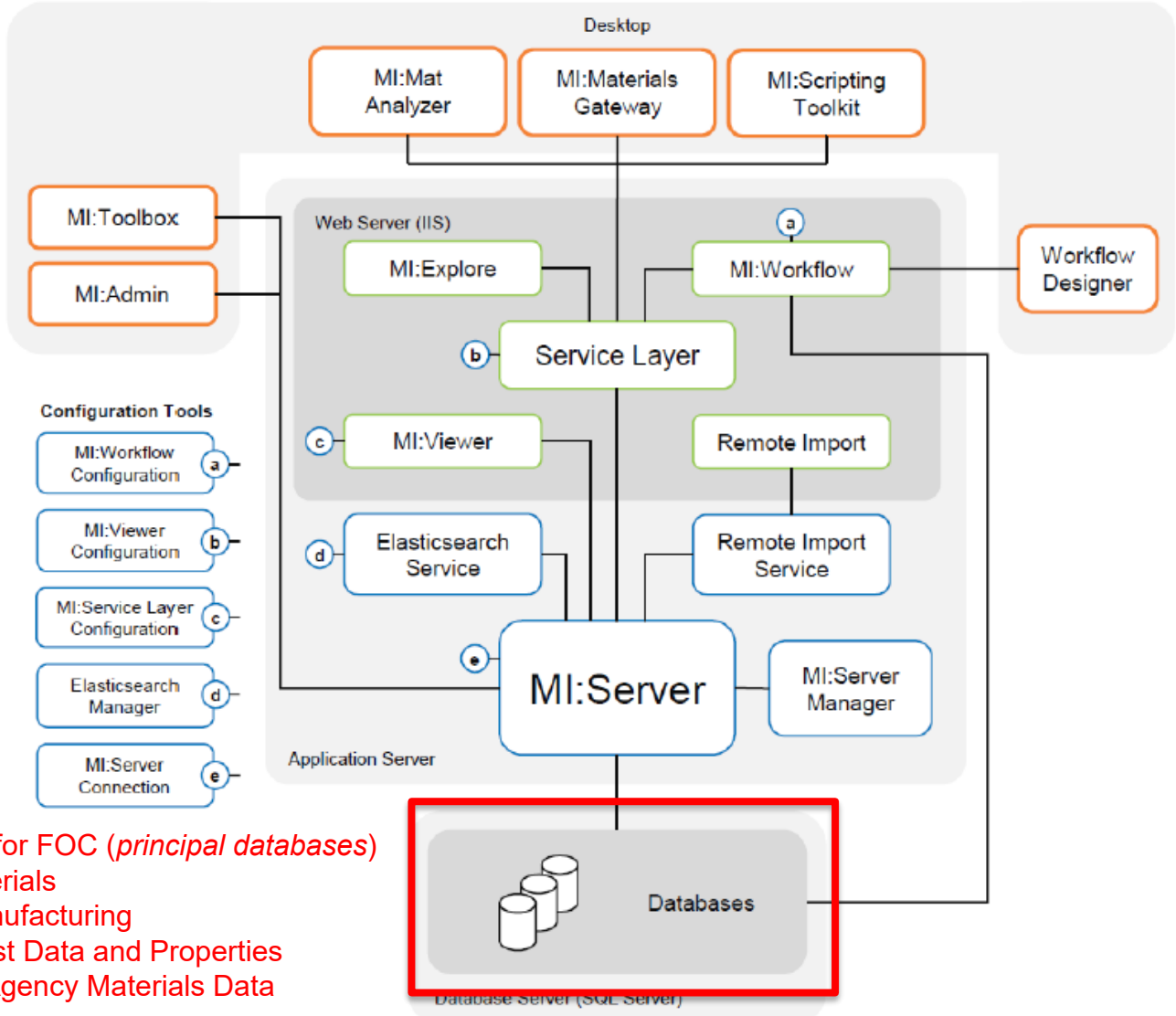


Essential functionality requires a minimum amount of legacy data in GRANTA MI



Minimum data for FOC (*principal databases*)

- At-Risk Materials
- Additive Manufacturing
- Materials Test Data and Properties
- Production Agency Materials Data

Structure of Implementation

FOC is achieved when essential functionality is delivered

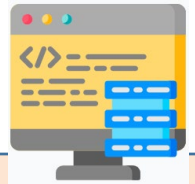
- **Essential functionality requires delivering in 4 sub-projects *(Epics)*:**

System Infrastructure

- Server implementation
  - Classified and unclassified
  - Backups and tests
  - Access request processes
- Authentication
  - OAuth2 implementation
  - License/usage tracking

Database Creation and Population

- Principal db development
  - Design data schema
  - Design access control schema
  - Create upload tools
- Principal db population
  - Upload legacy data
  - Migrate from local to shared servers



Application Configuration and Integration

- Application configuration
  - GRANTA MI components
  - Homepages & interfaces
- Application integration
  - Python
  - Creo
  - FEA (Sierra, Dyna, etc)
  - PDMLink

Training and Documentation

- Training
  - SMEs to help design schemas
  - Data generators to upload
- Documentation
  - Database usage and best practices
  - Reference documentation for data generators

- **Different personnel are required to ensure success in each epic**
- **Each epic will be led by an Epic Leader**
- **Each epic has *measurable* deliverables, grouped into *Stories***

Deliverables take time and have dependencies, so multiple *Phases* of the project are needed

Epic	Story	Major Deliverables		
		Phase 1	Phase 2	Phase 3
System infrastructure	Server implementation	• Unclassified server deployed • Test suites developed • Process for access request & approval developed • (Maintenance of classified server)	• Process for license and usage monitoring developed • (Maintenance of test suite) • (Maintenance of both servers)	• (Monitoring of license and usage) • (Maintenance of test suite) • (Maintenance of both servers)
	Authentication method	• OAuth2 tested and implemented		
Database creation and population	Pilot database development	• Gather from sites and document use cases • Data schema designed • Access control schema designed	• Schema tested at all sites • Tools and workflows for uploading data developed • Tools and workflows for uploading data documented	• Upload tools and workflows tested and implemented for new and legacy data • Modify schema in response to user feedback
	Pilot database population		• Catalog legacy data for upload	• Legacy data uploaded • Local databases moved to shared servers • Data moved from local to shared servers

Application configuration and integration	Application configuration	• Applications available
		  ○ MI:Viewer
		  ○ MI:Explore
		  ○ Remote Import
		  ○ FEA Export
		• MI:Explore configured for reference databases
		• System-level homepages configured
			• Applications available
			  ○ MI:Toolbox
			  ○ MI:Admin
			  ○ MI:Mat Analyzer
			  ○ MI:Software Development Toolkit
			  ○ MI:Materials Gateway
			• Profile and database homepages configured
			• MI:Explore configured for pilot databases
			• Reporting tools for pilot databases created
				• (Maintenance of all configurations)

	Application integration	• Creo and Python integration established • FEA Exporters configured for reference databases	• Creo and Python integration deployed • FEA Exporters configured for pilot databases	
Training & Documentation	Training	• SMEs for database development trained	• Data generators trained	• (Periodic training for new users)
	Documentation	• Documentation of reference database usage and best practices	• Reference documentation for data generators	• Documentation of pilot database usage and best practices • (Maintenance of documentation)

Major deliverables from each epic/story will be accomplished during each phase of implementation

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Support from all sites is required

- All sites will need to collaborate on:
  - Schema design
  - Testing tools & integrations
  - Training and documentation
  - Change control
- Sites have local databases that will be moved to shared servers
- Local site servers will be retired
- Sites will provide their own cost estimates

There are assumptions, and risks will be managed

- **Assumptions**
  1. NNSA leadership is able to secure funding for this implementation and continuing O&M at all sites.
  2. LANL is able to identify personnel matching the skills described in Table 5.
     - Hiring will need to be done in FY21.
  3. Granta will implement standard authentication (OAuth2) as planned.
  4. NNSA programs will support continued population of the principal databases with new data after they are implemented.
  5. Integration with other software tools will be as effective as it is on local GRANTA MI installations.

- **Risk Management**
  - Implementation plans for each epic will be written, and progress of each epic will be tracked by Epic Leaders.
  - Project risks will be tracked by the GRANTA MI Project Leader. Frequent teleconferences (at least once per month) and face-to-face meetings (at least four times per year) will facilitate sufficient communication so that issues can be identified early.