Developing a National Interstate Data Exchange Application System for NPCR (N-IDEAS): A CMMI Approach

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Abstract

The state cancer registry collects cancer data regardless of where the cases were diagnosed or treated. The exchange of data between cancer registries is important to ensure data completeness and evaluation. The information technology solution using N-IDEAS provides a way of secure data exchange.

Following the Capability Maturity Model Integration (CMMI) process improvement approach throughout the software development life cycle (SDLC) to implement the solution helps us provide a quality product in a timely manner for NPCR.

The N-IDEAS provides technical assistance to facilitate secure data exchange between state cancer registries. The system provides monitoring and tracking of data exchange for CDC reporting. CMMI-based processes were followed to streamline the development process.

Background

- The model central cancer registry (CCR) collects complete population-based data for a defined geographic area regardless of where the cases are diagnosed or treated. CDC funding announcements stipulate that National Program of Cancer Registries (NPCR)-funded CCRs are to capture information on patients who are not residents of the geographic region, and are to exchange that information with the resident geographic region. In some instances, data received through interstate data exchange agreements account for approximately 15% of the cases in the CCR's database. Existing state laws, rules, and/or regulations currently allow most NPCR CCRs to exchange data with other CCRs.
- It is important to ensure data security and confidentiality of the data collected by CCR that includes Personal Identification Information (PII) such as name, SSN, DOB, Address and other personal information.
- A unified infrastructure can simplify the work to be performed during data exchange. Current infrastructure lacks a unified infrastructure that complies with policy and security requirements.
- Current barrier to inter-state data exchange among CCRs:
  - Legal barrier: Legal agreement for inter-state data exchange, state laws, and regulations
  - Resource and cost barrier: Technical staff, IT infrastructure, and funds
  - Different means of data exchange including Web, Secure FTP, Secure email, and Disc depending on the data agreement.

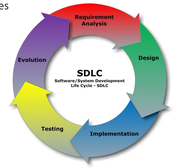
Summary

- The Software Engineering Institute (SEI) of Carnegie Mellon developed the Software Capability Maturity Model (SW-CMM) officially released in 1991 superseded by the Capability Maturity Model Integration (CMMI) in 2000. The CMMI is a set of guidelines for process integration and product improvement designed to help projects and organizations improve performance. Organizations such as ICF, IBM, BAE Systems, General Dynamics, and others adopted CMMI guidelines to assist in improving quality and overall organizational performance and are assessed by SEI authorized appraisers to ensure adherence with the CMMI.
- ICF is contracted to develop National Interstate Data Exchange Application Systems (N-IDEAS) to help CDC/NPCR address data completeness. The exchange of data among CCRs is essential to assure complete and timely data are available to accurately evaluate the burden of cancer at the local, regional, and national levels in support of comprehensive cancer control efforts. Data included in interstate data exchange is not limited to selected cancer sites, but incorporates all cancers.
- The n-tier architecture of the N-IDEAS application utilizes the existing secure NPCR-CSS Server. The no-cost client application will be installed on the NPCR-funded CCRs' computer system allowing them to perform appropriate computer edit checks to assure data quality and automatically creates encrypted files for the receiving central registry. N-IDEAS provides NPCR with a reporting website to monitor data exchange activities, while maintaining privacy protections, to assure that funded CCRs are adhering to required activities and NPCR Program Standards.
- N-IDEAS uses FIPS 140-2 compliant cryptography standards defined by NIST for security compliance. The application uses HTTPS protocol and public key infrastructure as security measures.
- All data transmitted through N-IDEAS will be solely for the purpose of exchanging data between central cancer registries. The confidential data within N-IDEAS will be subject to appropriate legal, security, and technological protections and will not be accessible by CDC or its contractor. Confidential data contained within N-IDEAS is not a deliverable from the contractor to CDC.

Methodology

CDC - Enterprise Architecture - System Development Life Cycle

- CDC's Enterprise Architecture – System Development Life Cycle consists of five phases: Evolution, Requirement Analysis, Design, Implementation, and Testing.
- Project Management is the application of knowledge, skills, tools, and techniques to project activities in order to meet project requirements. Project Management establishes processes for scope management, time management, cost management, quality management, human resource management, communication management, risk management, procurement management, as well as integration management of all of these processes.



N-IDEAS Project Life Cycle

- **Project Planning**

  The Project Planning phase involves establishing project parameters, developing integrated plans, and obtaining stakeholder commitment and acceptance of the project plans. The Project Manager and the Project Team identify risks, and develop estimates of effort and cost. At the end of the Project Planning phase the N-IDEAS Project Manager and Project Team had developed a Project Management Plan, Work Breakdown Structure (WBS), Risk Management Plan, Configuration Management Plan (CMP) and received approval from the stakeholders.
- **Requirements Development and Design**

  The Requirements Development phase ensures an agreed upon set of requirements between stakeholders and the Project Team is established. The System Design Document and Requirements Traceability Matrix were generated from the Scope of Work and stakeholder input. The Change Management Process was defined for processing changes to the requirements after the approval of the documented requirements.
- **Development, Integration, Testing and Deployment**

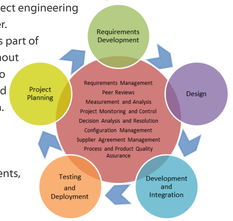
  During development, integration, testing and deployment activities, certain industry standards were followed; A Test Plan, Deployment Plan and Test Scripts were created, and the State CCR participated in System Pilot Test to validate the product.

Requirement Traceable Matrix for N-IDEAS

Module	Req. ID	Requirement Description	Requirement Type	Requirements Source	Release	Priority	Risk	Design	Test Script ID	Status
Inbox	1.5	Files that have been downloaded already are in normal-weight font	Quality	Client Specification V3.1	Release 2.0	Normal	Medium	Design ID 1.1	45	Deployed
Inbox	1.6	Each column is sortable ascending and descending.	Functional	Client Specification V3.1	Release 2.0	Normal	Medium	Design ID 1.1	46	Deployed
Inbox	1.7	Checking the checkbox in the column header will check all rows.	Functional	Client Specification V3.1	Release 2.0	Normal	Medium	Design ID 1.1	47	Deployed
Inbox	1.8	Unchecking the checkbox in the column header will uncheck all rows.	Functional	Client Specification V3.1	Release 2.0	Normal	Medium	Design ID 1.1	48	Deployed
Inbox	1.9	Click "Download..." to download one or more selected rows.	Functional	Client Specification V3.1	Release 2.0	Critical	High	Design ID 1.1	49	Deployed
Menu Items and Preferences Dialog	1.10	Download function opens a standard Windows "Save As" dialog that defaults to the user's download folder preference or last folder used. Default value should be set under "Edit" menu > "Preferences". See Menu Items and Preferences Dialog.	Functional	Client Specification V3.1	Release 2.0	Normal	Medium	Design ID 4.1	50, 51	Deployed
History	1.11	Instances of downloading are recorded as list items on the History tab. See HISTORY Tab	Functional	Client Specification V3.1	Release 2.0	Normal	Medium	Design ID 3.1	52	Deployed

Project Life Cycle (PLC) /CMMI

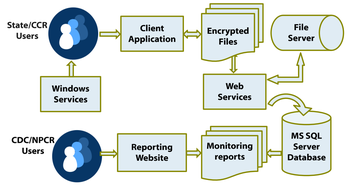
- The objectives of ICF standards and processes for the Project Life Cycle are: to ensure compliance with Capability Maturity Model Integration (CMMI) for development and to conduct project engineering activities in a standardized manner.
- The PLC guidelines are followed as part of Project Management and throughout the development of the product to ensure proper documentation and clear understanding of the system.
- As a result of implementing the activities of the Project Life Cycle, a better product is produced that meets the agreed upon requirements, on schedule and within the established budget.



System Architecture and Design

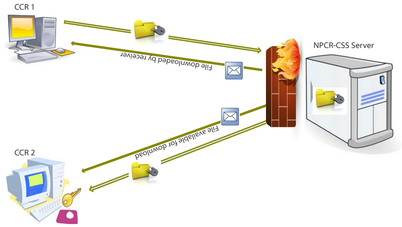
The system is comprised of following components:

- Client Application: A desktop application on CCR users' machines to allow CCR users to exchange data with other CCRs. Performs optional edits and provides history of data exchange.
- Reporting Website: Provides CDC/NPCR with monitoring and reporting of data exchange activities among CCRs.
- Web services: XML web services are used to transfer data files over a secure HTTPS network as well as notification services to inform users of available exchange.
- Windows Services: Automatic deletion of expired files from the server.



System Features

- N-IDEAS facilitates peer-to-peer secured data exchange among CCRs.
- Two CCRs can use N-IDEAS to exchange data as long as they have a data exchange agreement in place.
- Option to run EDITs using different metafiles, before sending the file is available.
- Automatic email notification feature enables CCR to be informed of the data exchange process.
- Data files remain encrypted throughout the transaction, which provides security protection so that CDC or its contractor don't have access to the data.
- A simple and easy to follow user interface, requires minimal technical training.
- A user manual is available with the application with easy to follow instructions on how to use the data exchange client application.
- ICF provides dedicated helpline for technical support.



Security Features

- The system provides double encryption in the form of encrypted file transferred using HTTPS protocol.
- System uses Advanced Encryption Standard (AES) defined by National Institute of Standards and Technology (NIST) FIPS 140-2 compliant encryption.
- Security applied so that files on NPCR-CSS server will not be accessible to CDC or its contractor.
- Encrypted file is only accessible to receiver.
- File automatically deleted after expiration, never stored permanently on server.
- System uses public key infrastructure for key generation.
- Password is encrypted during transaction.

Outcome

- Support CDC/NPCR's cancer surveillance improvement efforts by addressing the issue of secure data exchange among CCRs.
- Unified infrastructure to facilitate secure data exchange between NPCR funded CCRs.
- Implementation of the CMMI standard approach allowed ICF to enhance process and project management and led to optimization of project outcomes.

Benefits of Using CMMI PROCESS

- Better project management and development process.
- Better budget and cost control
- Better risk management
- Better resource and time management
- Better documentation and deliverables monitoring.

BENEFITS for CDC/NPCR

- Improved registries' operation and better quality of cancer surveillance data.
- Better Surveillance and improved services.
- Better program management and monitoring.

BENEFITS for Central Registries

- User friendly secure electronic data exchange and reporting.
- Unified infrastructure and process.
- No extra cost.
- Better technical assistance to CCRs.

Conclusion

- The N-IDEAS is another product developed for CDC/NPCR that can be widely used to help cancer registries in their data collection and operation improvement efforts.
- N-IDEAS open to all North American registries.
- The CMMI approach for product development streamlines project management processes and provides the product within the timeline that meets the users' requirements. Following CMMI-based process is efficient, which can be adopted by any software development efforts related to for cancer registry process.
- The product architecture for N-IDEAS can be expanded for any peer-to-peer data exchange application.
- A pilot implementation of the project has been performed with selected NPCR states. We encourage state CCRs to use N-IDEAS and leverage its benefits. This is an easy to use secure data exchange system.
- The product complies NIST standards for security: Advanced Encryption Standards (AES). Even encrypted data is sent over HTTPS protocol, making the data exchange more secure.

Acknowledgement

- **CCR - Involved during Pilot Testing of N-IDEAS**

  Alaska Cancer Registry
  Michigan Cancer Surveillance Program
  North Dakota Statewide Cancer Registry
  Florida Cancer data System
  Cancer Data Registry of Idaho
  Mississippi Cancer Registry
  Georgia Comprehensive Cancer Registry
  Kentucky Cancer Registry
  Montana Central Tumor Registry
  Louisiana Tumor Registry
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The findings and conclusions in this report are those of the authors and do not necessarily represent the official position of the Centers for Disease Control and Prevention.