2023 NSRP All Panel Meeting

The Center for Naval Shipbuilding and Advanced Manufacturing presents the Navy ManTech Project

S2802 – Advanced Diagram Development and Management

(A collaboration effort between ONR, NSAM, and GDBIW)

PoP May 2019 – January 2023

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Agenda

- Acknowledgements
- Objectives/Goals
- Background
- Benefits
- Technical Approach
- Status/Results
- Conclusions
- Additional Information

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Acknowledgements

- **Project funding provided by the Office of Naval Research (ONR) Navy ManTech Program**
- **Navy ManTech program oversight provided by**
  - Paul Huang – ONR Program Officer
  - Bobby Mashburn – Deputy Director
  - Robert Conley – Center for Naval Shipbuilding and Advanced Manufacturing Project Manager
  - Victoria Dlugokecki – Project Technical Representative
- **Bath Iron Works**
  - Sarah Glazier – Project Manager
  - Jim Strickland – Technical Lead

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Objectives/Goals

- Develop a standardized and integrated data architecture to store drawing information
- Use the architecture to create intelligent, linked, attributed, and standard products
- Project goals include:
  - ↗ **Reduce Labor Costs:** The labor hours required to create and maintain diagrams is expected to be reduced when tools are deployed and data is organized in a consolidated fashion
  - ↗ **Reduce Rework:** Rework attributed to errors due to misinterpretation of requirements, incorrect data entry or using incorrect diagram elements will be reduced or eliminated
  - ↗ **Improve First Time Quality:** Data will be more easily controlled and pulled from a consolidated data environment, leading to more accurate, higher quality products

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Objectives/Goals

- Develop data architecture tools that can be used to integrate automation in the creation and maintenance of “intelligent” 2D electrical drawing products with the goal of ensuring standardization, reduction of effort, and improved quality
- Create the tools that are needed to incorporate data driven diagram creation and presentation
- Demonstrate the capability to interface to various data sets and diagram software tools
- Document diagram configuration management and attribution
- Manage the data rather than managing the representation

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Background

- Electrical diagram development and maintenance is done manually through the use of AutoCAD 2D drawings. The electrical diagram drawing components did not have attributes associated with them and there are no specific intelligence or links built into the drawing. Tabular data stored in parts tables or other generated lists were not linked to the objects on the drawings, requiring manual intervention of data sets each time there was a change
- Potential existed to introduce more advanced diagram development and management through the use of “intelligent” 2D electrical drawing products, where drawing components are attributed, and include engineering, design, and planning details within the components description.
- A focus was to develop a standardized and integrated data architecture to store drawing information. The project built from this architecture approach to automatically create intelligent, linked, attributed, and Engineering and Design configuration items and products. Users will manage the processing of the data, rather than the visual presentation of the functional requirements.

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Benefits/Payoff

- **Reduce Hours Associated with Diagram Development and Management**
  - ↗ 35.8% reduction
- **Reduce Hours Associated with Production Rework Cost Avoidance**
  - ↗ 14.8% reduction
- **Reduce Hours Associated with Engineering and Design Rework Cost Avoidance**
  - ↗ 28.6% reduction
- **Savings Assumptions**
  - ↗ Engineering and design savings is based on an average of 4 years of nominal change and 1 year of high change work
  - ↗ Manufacturing cost avoidance is based on categories of rework associated with incorrect information that flowed from engineering and design to manufacturing
  - ↗ Engineering and design cost avoidance is based on categories of rework associated with incorrect information that was caught during the check and validation process
  - ↗ Qualitative benefits are not specifically quantified

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Benefits/Payoff

- **ManTech Investment - $1,815,164**
- **Implementation Costs - $939,500**
  - ↗ DDG140 first hull of benefit
- **Savings - $1,104,875 per year**
  - ↗ 35.8% Reduction – Diagram Development and Maintenance
  - ↗ 14.8% Reduction – Production Rework Cost Avoidance
  - ↗ 28.6% Reduction – Engineering and Design Rework Cost Avoidance
- **Per Hull Savings (1.1 hulls/year) - $1,004,432**
- **Five Year Savings - $5,524,375**
- **ROI = 1.01**

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Technical Approach

Task	Description
Phase I	**Technology Assessment**
1	Current State / Future State Process Analysis and Roadmap
2	Vendor Assessment
3	Develop Roadmap
4	Define software architecture, tools and interfaces
5	Phase I Report / Review with Go / No-Go Decision
Phase II	**Architecture Design and Development**
6	Develop software architecture, tools and interfaces
7	Pilot integrated system architecture with back end interfaces
8	Implementation Plan and final reporting

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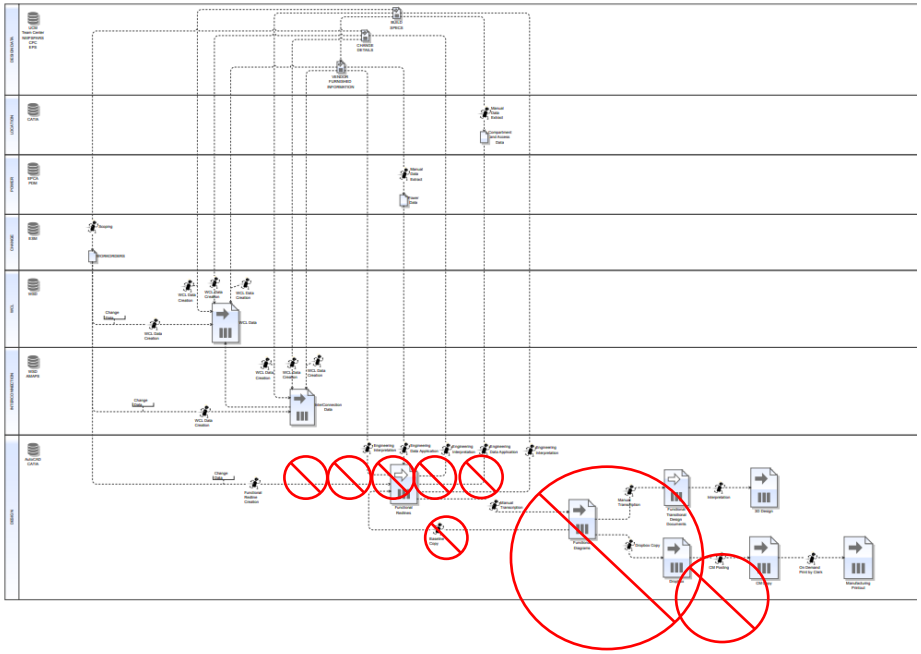
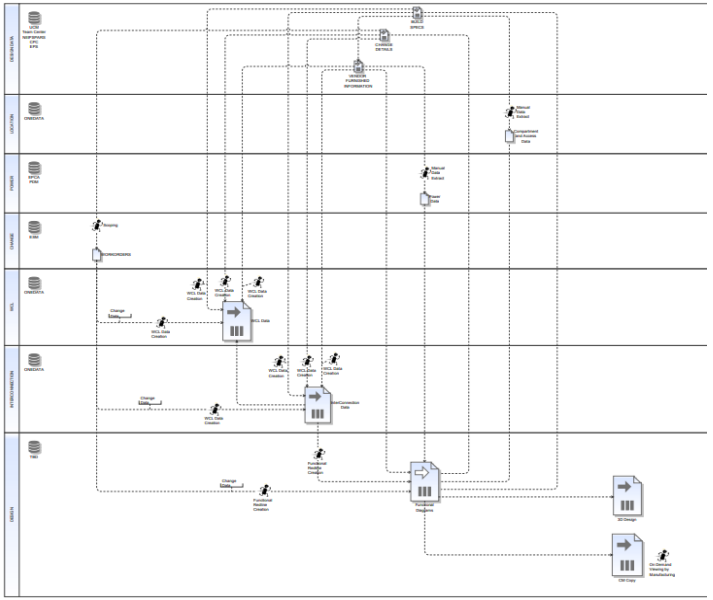
Technical Approach: Current State/Future State

- Non-value added manual interactions and intermediate products were removed
- Data flow converted to operate automatically where possible

6.1 Data Flow Current



6.1a Data Flow Future



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Technical Approach: Vendor Analysis

- **Over 50 criteria were evaluated across 5 primary interest areas**
  - ↗ Technology and Technical Capacity
  - ↗ Customization/ Flexibility
  - ↗ Customer Service and Support
  - ↗ User Experience
  - ↗ Affordability (NRE and Lifecycle)

Summary Category	Category - Sub Category
Technology & Technical Capability	Design Viewer - **Branch**
	Design Viewer - **Ship Applicability**
	Design Viewer - **Type/Name/Sheet/Subsheet**
	Design Viewer - **Archive**
	Library Parts Management - **Diagram Type**
	Library Parts Management - **Usage**
	Library Parts Management - **Attributes**
	Library Parts Management - **Version Control**
	Diagram Management - **Diagram Type**
	Diagram Management - **Borders**
	Diagram Management - **Custom tables**
	Diagram Management - **Permission control**
	Diagram Development Tools - **Front Matter Data UI/storage**
	Diagram Development Tools - **Automated Front Matter**
	Diagram Development Tools - **Automated Object creation**
	Diagram Development Tools - **Automated Attributes**
	Diagram Development Tools - **Automated Offsheets**
	Diagram Development Tools - **Smart lines/ line tracking/ hops**
	Data Management - **Ship Applicable Data consolidation**
	Data Management - **Integrated Data Support**
	Data Management - **Input APIs**
	Data Management - **Output APIs**
	Data Management - **Customer Effort/ Maint. & Config**
	Release Management - **Diagram Version Control**
	Release Management - **Automated Revision History**
	Release Management - **Change Support/Branch**
	Error Mitigation - **Automated Maintenance**
	Error Mitigation - **Error Reports**
Customization / Flexibility	Vendor - **Customization**
	Vendor - **Integration with current Architecture**
	Vendor - **Integration with PLM**
	Vendor - **Security**
	Vendor - **Expertise and Partnerships**
Customer Service & Support	Vendor - **Support & Maintenance**
	Vendor - **People/Customer Service**
	Vendor - **Vendor Stability**
	Vendor - **Product Stability**
	Vendor - **Product Support**
User Experience	Vendor - **Startup Ease of Use/Training**
	Vendor - **Long Term/Operational Ease of Use**
	Vendor - **Professional/Complete look & feel**
Affordability (NRE & LifeCycle)	Vendor - **Cost- Non-Recurring Engineering**
	Vendor - **Cost- Customization**
	Vendor - **Cost- Lifecycle/ Support**

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Technical Approach Roadmap

- **Documented high level process for implementing ADDM**

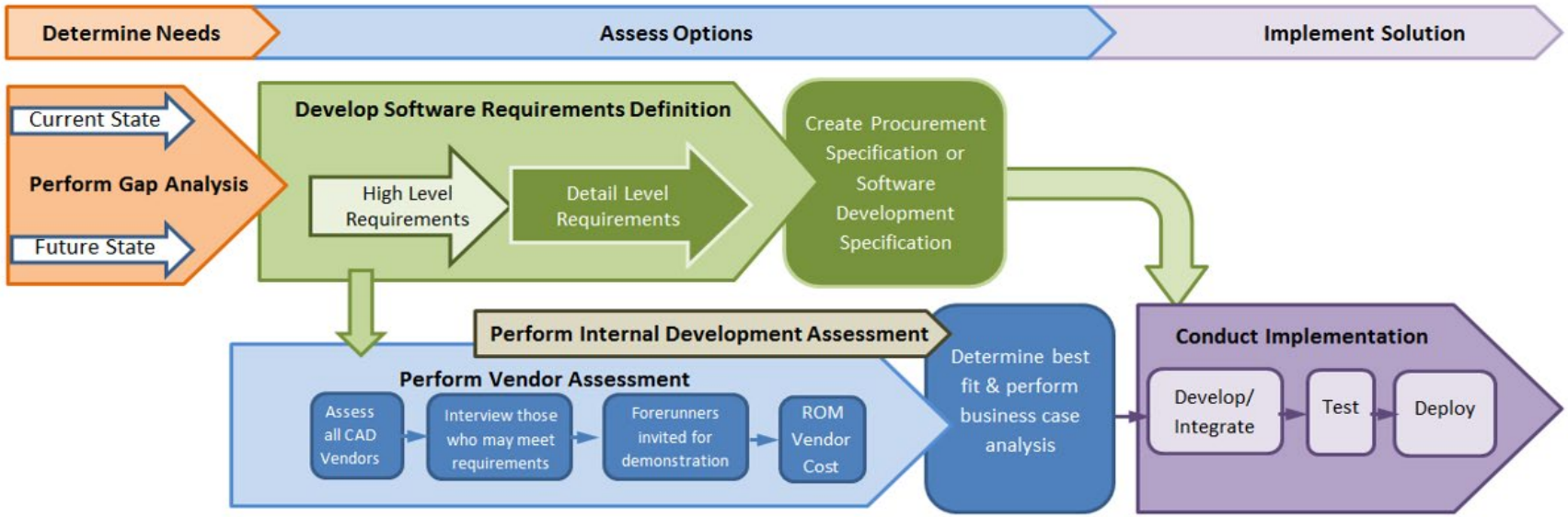

Figure 2-1: ADDM Roadmap Process Flowchart

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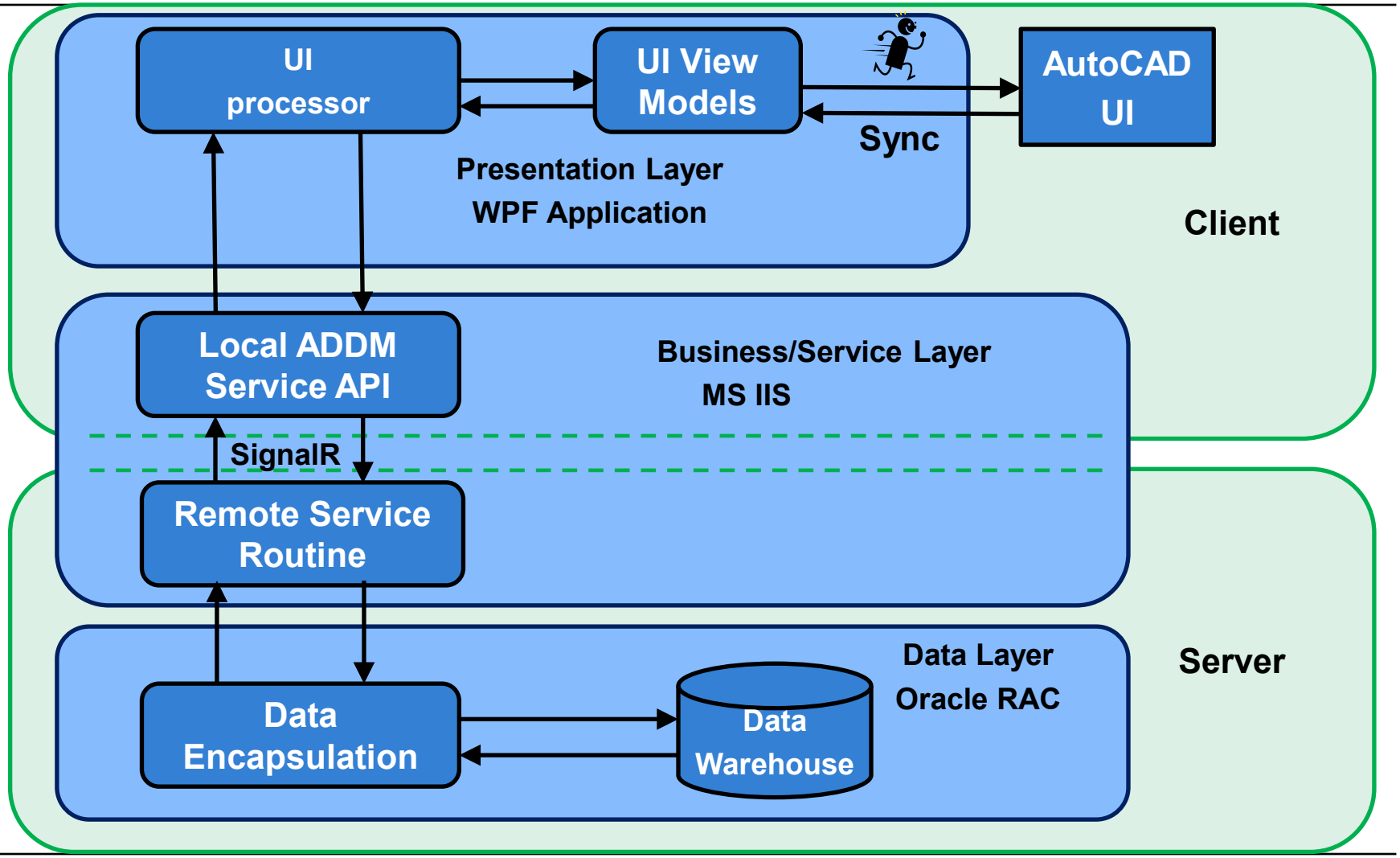
Technical Approach: Architecture



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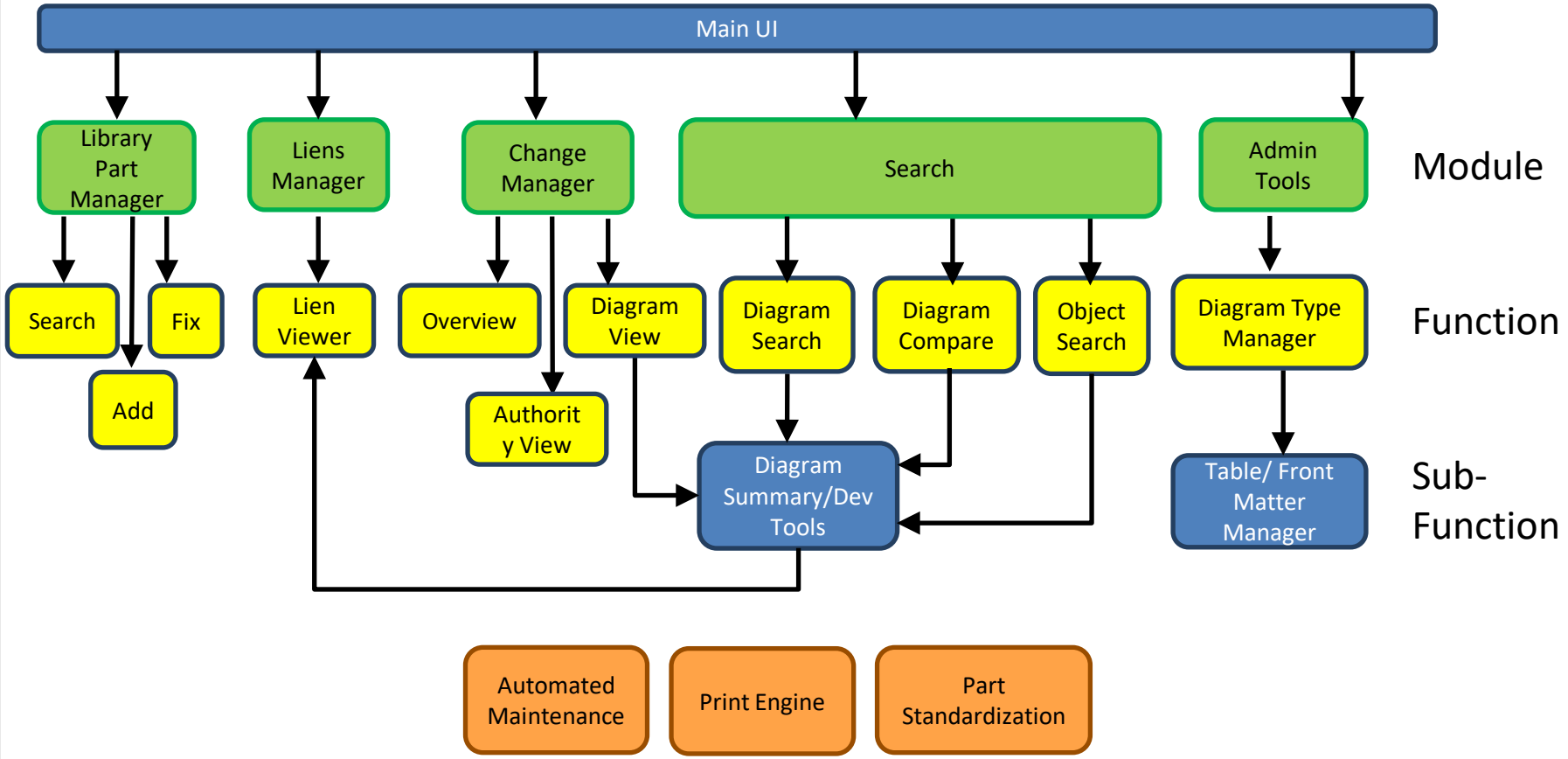
Technical Approach: User Interface Overview



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Status

- The project was successfully completed and project goals were met
  - ↗ Phase I
    - All Phase I tasks completed and project received “Go Recommendation.” Build decision made and BIW with sub-contractor assist to develop
  - ↗ Phase II
    - Due to performance concerns, sub-contractor contract terminated and BIW completed remaining project development and testing activities
    - BIW internal team successfully developed, tested, and delivered ADDM system
    - Positive Business Case ROI realized with additional use cases identified for future expansion
    - Additional development to support implementation is required

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Conclusions

- Advanced Diagram Development and Management project provided valuable insight into BIW's current processes and procedures
- Architecture and process review allowed for better integration with internal systems such as Manufacturing Support Tools project/implementation
- Software is expected to provide significant benefits upon implementation with additional opportunities for expansion
- There is business support for implementation and additional resources required for a successful launch and adoption

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