ACQUISITION INNOVATION
RESEARCH CENTER

Report on

Joint Capabilities Integration and Development System (JCIDS)

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EXECUTIVE SUMMARY

The **Joint Capabilities Integration and Development System (JCIDS)** in the U.S. Department of Defense (DoD) has come under increasing scrutiny over the past decade, with a particular focus on its latencies. Since a validated requirement is needed before an acquisition program can begin, delays in the JCIDS process were perceived by Congress as adding months or even years to the acquisition cycle. In support of the DoD's response to Congressional concerns, the Acquisition Innovation Research Center (AIRC) was asked to assess how it can improve the efficiency of developing and approving capability requirements and to develop a model to show the effects of proposed alternatives.

In preparing this assessment, we worked closely with the JCIDS process facilitators (called Gatekeepers) in the Joint Staff and Military Services. The Gatekeepers' role is to ensure quality in documentation and adherence to current JCIDS policies. The Gatekeepers provided a limited set of data on actual time consumed to staff and approve 20 Navy sponsored validated requirement documents. We treated the data as representative of an average document but had no insight into classified document content or complexity. We modeled the current JCIDS process using the data provided and found that the current JCIDS process for preparing and validating an Initial Capabilities Document (ICD) followed by a Capabilities Development Document (CDD) was an average of 852 days.

We examined potential improvements at three levels based on the available (limited) data and other ideal timelines. Hence, we identified potential levels of schedule improvements to reduce the time to validate a requirement. To ascertain whether the magnitudes of improvements are achievable, more in-depth analysis would be required to "walk the process" with discussions of key participants in each step to collect detailed data estimates such as those recommended by the McManus (2005) Value Stream Mapping and Data Collection Sheet.

We examined potential improvements at three levels:

1. **Make the current JCIDS staffing process leaner (reduce delays)**: With no change in policy, we found that standard lean process improvement techniques had the potential to reduce end-to-end time by 25% or more.
2. **Change JCIDS process steps and documentation requirements:** A discrete-event simulation showed that combining the ICD and CDD into an integrated document (an Initial CDD with an update) potentially could reduce the 852 days to an average of 444 days. The simulation showed that changing JCIDS to more broadly use SOCOM's expedited Special Operations Rapid Requirement Document (SORRD) process could reduce the time to an average of 309 days. Again, more research is needed to substantiate the actual impact of such improvements.
3. **Make further changes to better align JCIDS with the Defense Acquisition System using the Adaptive Acquisition Framework[1] and the PPBE budget process:** Based on a literature review and interviews with experts on best practices, we identified ideas meriting further consideration to improve JCIDS in the context of "Big A" (e.g., major) acquisition. These ideas include an expanded cadre of certified civilian requirement professionals, similar to the 1101s in the acquisition corps, (to improve the quality & speed of initial requirement documents), cross-functional teams, model-based mission engineering and portfolio management, adoption of automated workflow management and AI assistance for requirements authoring and staffing, and good governance principles. We believe these ideas have the potential to make JCIDS faster, more collaborative, and better integrated with the other "Big A" functions.

JCIDS Process Improvements Considered	
CHANGE	**POTENTIAL EFFECTS**
1. Make current process leaner	25% (or more) faster
2. Overhaul process and documents • Integrated CDD • SORRD Rapid Requirements	852 → 444 days 852 → 309 days
3. Better alignment with Big A Acquisition	• Documents authored by professionals • Portfolio-level tradeoffs • Better collaboration in Agile Acquisition Framework

Table ES-1: Effects of JCIDS Changes Considered

[1] See: DoD Instruction 5000.02 (DoD, 2022).

Based on this analysis, we offer the following recommendations:

A. Adopt an Agile JCIDS Framework

Revise the current JCIDS documentation and staffing process to adapt to the nature of the requirement, starting with pilot programs in each Service. For requirements expected to result in an ACAT I size solution, adopt the Integrated CDD process that eliminates steps by eliminating the ICD and incorporating an Initial CDD (I-CDD), while maintaining the Analysis of Alternatives (AoA) between the I-CDD and final CDD. For other requirements, at the ACAT II or ACAT III size, make the SORRD process the preferred process, coupling with MiddleTier Acquisitions. Assess the results of these pilots and update the JCIDS process accordingly.

B. Streamline the JCIDS staffing process

Establish a team of stakeholders to apply Value Stream Mapping to staffing steps that remain in JCIDS under Recommendation 1 (on the preceding page). Charter the team to "walk the process" on several JCIDS examples, collect data, and streamline process steps using the methodology of McManus (2005). Revise the JCIDS manual and Service counterparts based on this analysis.

C. Enforce JCIDS schedules

Establish and track suspense dates for steps in the JCIDS process in both Joint Staff (JS) and Service task assignment systems to give JCIDS documents the same high priority that other important documents receive. Capture data from these systems to make it easier to analyze JCIDS and eliminate process constraints.

D. Clarify end-to-end governance of the requirements process

JCIDS is the culmination of the overall requirements process, which is a critical input to "Big A" acquisition. The requirements process starts with a warfighter need upstream of JCIDS staffing. Update the JCIDS manual to include the frontend Service and COCOM responsibilities for gap analysis. Also, include the initial document drafting and provide for early collaboration among the key stakeholders to address joint requirements.

E. Review additional ideas for applicability to JCIDS

1) Establish an expanded cadre of certified civilian requirement professionals (similar to 1101 acquisition professionals and financial management professionals) to support the military and ensure initial quality in requirements documentation.

2) Shift to persistent requirements baselines and gap analysis at a portfolio level

3) Expand collaboration in Cross Functional Teams

4) Support requirements development with a Workflow Management System and authoring tool

These recommendations are clearly beyond the purview of the Gatekeepers we worked with and will require attention from senior leaders across the DoD requirements and acquisition communities.

INTRODUCTION

The Joint Capabilities Integration and Development System (JCIDS) has come under increasing scrutiny since its inception in 2003, with a particular focus on its latencies. Our ability to be successful in maintaining a warfighter advantage is dependent on the use of capabilities with the latest technologies. The warfighters are motivated to use state-of-the-art technology to maintain a military advantage over adversaries. Today, many technology generations typically evolve at a rate of once every two years (Schwartz, 2014). However, the validation of a requirement through JCIDS often takes longer than two years to identify capability gaps and decide on a solution approach. It is critical to the Department of Defense (DoD), and the United States in general, that the sources of the latencies within JCIDS are identified and addressed.

JCIDS is the process by which the military develops and validates capability requirements for joint (more than one Service) use and interoperability. Service-level sponsors submit their capability requirements, which may then be assessed for their impact on joint operations and be developed into interoperable or joint solutions. The Service specific solutions can take the form of a materiel solution, an information system, policy changes, training, or doctrinal changes.

Interoperability across the services is a critical attribute within the United States military. Interoperability failures can pose a strategic weakness for warfighters and result in embarrassing episodes with political implications on the world stage. For example, the case of the Second Battle of Fallujah, or Operation Al Fajr (November - December 2004), highlights the danger of interoperability breakdown. During this episode, Army and Marine forces were working together to destroy enemy targets in the city. However, the two forces struggled to communicate with each other due to incompatible communication technologies: Army used radios while the Marines primarily used internet chat like Microsoft Chat (Matthews, 2006). Additionally, the two forces had different operating procedures when it came to communication: the Marines switched frequencies and codes according to a predetermined schedule while the Army resisted, thus further complicating communication efforts (Matthews, 2006). These interoperability weaknesses caused operational friction but could very well have caused catastrophe. As the DoD continues to rely on joint operations, interoperability is a primary consideration.

The seemingly straightforward JCIDS process is complicated by bureaucratic viscosity that affects all aspects of "Big A" acquisition, which includes the requirements process (JCIDS), the defense acquisition system (DAS) consisting of the Adaptive Acquisition Framework (AAF)[2], and the resourcing process (Planning, Programming, Budgeting and Execution (PPBE)). JCIDS interacts with the other two subsystems for support to address budgetary issues and acquisition for a given project. Additionally, the Joint Staff must interact individually with the service branches that sponsor the project. Both the Joint Staff and the Services have designated Gatekeepers to manage the JCIDS process. Nonetheless, service branches are not uniform in their JCIDS-related operations, and the Joint Staff must interact with each uniquely. The complexity of the organizational/human system that overlays a logical process gives rise to emergent behaviors that often result in process delays.

These delays have elicited reactions from Congress, Joint Staff, and service branches and resulted in the development of alternative pathways specifically tailored to bypass the mainstream JCIDS process:

- At the joint level, a software systems path was introduced to JCIDS to provide expedited requirements validation for software-based capabilities.
- Additionally, there is a Joint Urgent Operational Needs path for joint projects that, when given the right authorization, can allow sponsors to skip certain reviews present in the deliberate process.
- DoD Instruction (DoDI) 5000.80 sets policy on the use of the Middle Tier Acquisition (MTA) to "fill a gap in the [defense acquisition system] for those capabilities that have a level of maturity to allow them to be rapidly prototyped within an acquisition program or fielded, within 5 years of MTA program start" (DoD, 2019). The DoDI 5000.80 denotes the bypassing of the JCIDS process to support the ability to acquire current technology solutions for an existing in-scope validated requirement.

Still, it is important that the warfighters maintain joint interoperability. Avoidance of the JCIDS process may pose a risk to that objective. Yet, latency is also a critical threat to the warfighter. The delicate balance between jointness and speed must be maintained in a manner that best equips the warfighter for the abundance and complexity of global threats.

[2] USD(A&S), 2022.

STUDY APPROACH

Due to the existing issues in JCIDS, Congress found it important to direct the DoD (FY2021 NDAA Sec. 809) to "conduct an assessment of the processes for developing and approving capability requirements for the acquisition programs of the [DoD] and each military department; and develop recommendations for reforming such processes to improve the agility and timeliness of such processes."[3] In response, the DoD asked AIRC to develop a model of the current and proposed systems to show enhancements in effectiveness and efficiency. As summarized in Figure 1, we used a mixed methodology to identify the sources of delays and propose changes to speed up the JCIDS process. The sources are as follows:

1. We obtained a data sample for the calendar time consumed by steps in the JCIDS requirement definition and validation process.
2. Next, we used Value Stream Mapping to characterize the non-value-added delays in JCIDS and identify opportunities for making the current JCIDS process leaner, which would require no changes in policy.
3. Next, we used discrete event simulation to assess the potential schedule improvement achievable by changing the process and documentation requirements. Such changes would require revisions to policy documents.
4. Finally, our interviews and review of best practices provide qualitative insights and ideas that could strategically improve the requirement validation process in the context of Big A acquisition.

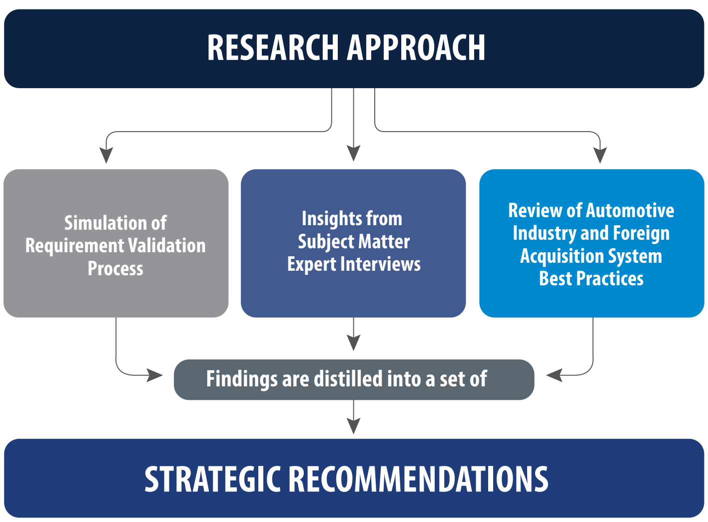

Figure 1. Outline of report structure.

[3] Section 809 of the William M. (Mac) Thornberry National Defense Authorization Act for Fiscal Year 2021, Public Law P.L. 116-283.

DATA SAMPLE

The data used for this project were extracted from the Knowledge Management/Decision Support (KM/DS) and provided by the Joint Gatekeeper. It consists of data on the time consumed in separate steps in the process for 20 different requirements documents. All documents were Navy sponsored and were submitted between 2016 and 2021. Each data point contains information on start and end date that the document had at the following stages: Sponsor, Gatekeeper (Navy), Stakeholder Commenting, Sponsor Comment Adjudication, Gatekeeper (Joint), Functional Capabilities Board (FCB), and Joint Capabilities Board (JCB)/JROC.

Because the JCIDS documents are classified, the study team had no access to the content or ability to categorize the complexity of the requirement. There is no identifying information regarding the acquisition category of the project associated with the document. This information is vital in understanding the scale of the project and could have provided additional insight into the causes of process delays. Consequently, we present our quantitative findings with the understanding that there are methodological limitations.

Further analyses of the provided data sample are presented in Appendix A, showing the distribution of elapsed times in the process-by-process step, by document type, and by start date.

In addition to the elapsed time data, we obtained the Navy Requirements Approval Process flow diagram, identifying the steps in the process and ideal target times, as shown in Figure 2.

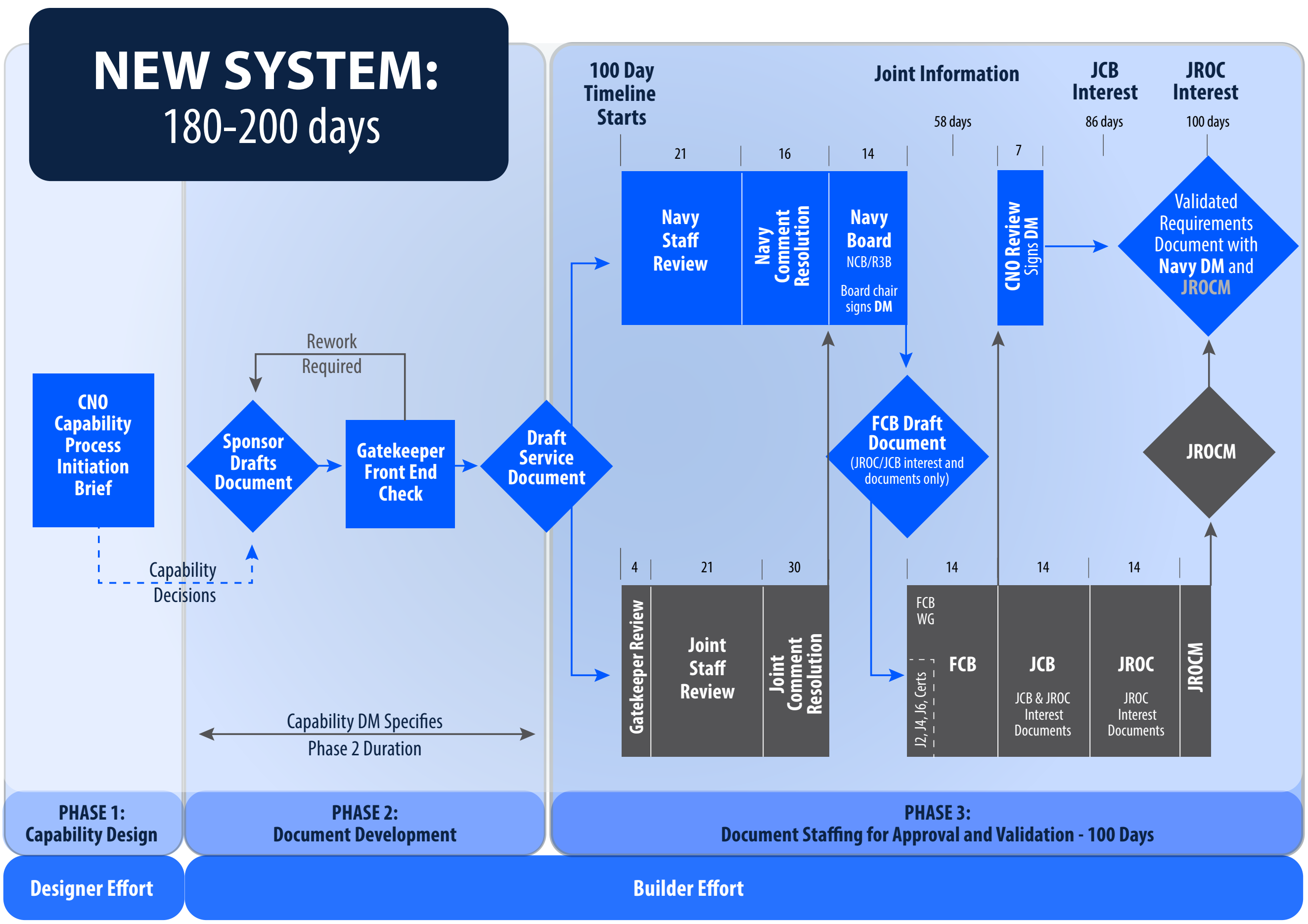

Figure 2. A flow chart of Navy-JCIDS document development and validation.

VALUE STREAM MAPPING TO MAKE JCIDS LEANER

Value Stream Mapping (VSM) is a widely used tool to reduce cycle time in lean manufacturing operations. Practitioners of VSM develop a process flow diagram that, for each step in the process, distinguishes the Cycle Time (CT, the elapsed calendar time for the step) from the In Process Time (IPT, the time active work is being performed). For manufacturing, the goal is to identify bottlenecks or constraints. In the case of the JCIDS document staffing process, the difference between Cycle Time and In Process Time is Wait Time, which may be a delay for reasonable scheduling of meetings or document comment cycles or may be an avoidable delay that adds no value to the JCIDS document. Wait time becomes a target for reduction or elimination in process improvement.

A key, and perhaps obvious, step in process improvement is identifying what a process is supposed to do and evaluating how the steps in that process help achieve the intended goal. In our context, JCIDS adds value to the larger U.S. military "Big A" acquisition system. We infer that the following, which are summarized in Figure 3, are the core value adding functions of JCIDS:

- Initial definition of capability requirements sufficient to support an Analysis of Alternatives
- Validate requirements for acquisition
- Identification of requirements for joint warfighting interoperability and joint acquisition opportunities
- Obtain coordinated inputs from key stakeholders across the expected life cycle of the materiel solution

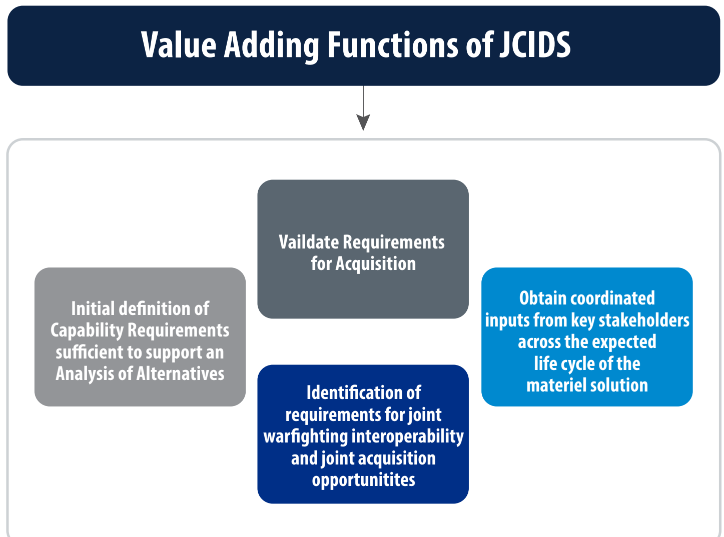

Figure 3. Chart of value adding functions of JCIDS.

McManus (2005) applies VSM to product development and defines the data collection needed to support such an analysis. While we lack the detailed data to apply this method to the JCIDS process, we used the sparse available sample data to illustrate the method. Figure 1 shows a simplified VSM for the joint Initial Capabilities Document process, annotated with CT estimates from our sample data and "ideal" IPTs from the Navy Requirements Approval Process.

Figure 4 shows an end-to-end time of over 400 days for an ICD, much of which is identified by the DoD as time waiting for reviews and approvals. If we accept the Figure 1 Navy ideal times as the minimum IPTs, this could theoretically be reduced to 184 days. A more in-depth analysis would require "walking the process" through interviews with key participants in each step and collecting the detailed data estimates recommended by the McManus (2005) Value Stream Mapping and Data Collection Sheet. Focusing on the Joint Comment Adjudication step alone could reduce the overall time by over 100 days (25% reduction). We believe this method shows promise for reducing latencies in the current JCIDS process, even without a change in JCIDS policy.

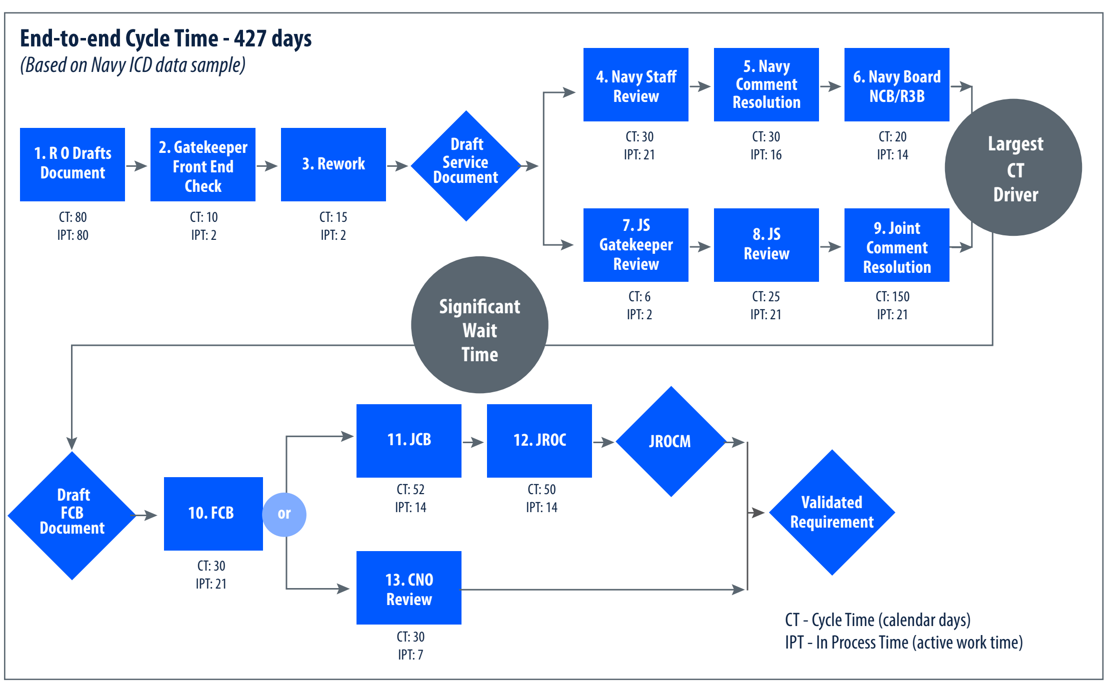

Figure 4. Simplified Value Stream Map for the Navy Joint ICD Approval Process.

DISCRETE EVENT MODELING TO EVALUATE ALTERNATIVES

While the value stream mapping effort provides valuable insights regarding improvements to the current state of JCIDS, they do not suggest disruptive changes to joint requirement validation. To explore potential innovations in the process, we sought to model and simulate JCIDS and proposed alternate processes that could reduce latency. We started with a literature search, summarized in Appendix A. This led to a discrete event simulation approach similar to the Enterprise Requirements and Acquisition Model (ERAM) (Wirthlin, 2009).

OUR SIMULATION MODEL

We developed a discrete event model that represents the Navy's current document validation. The 20 data points that we received provided actual times for individual requirement documents (ICDs, IS-ICDs, CDDs, CDD-Us, DCRs) but not the combined time required to review and approve both an ICD and CDD for the same acquisition program. Therefore, we developed a discrete event model to estimate the combined times. The model represents the Navy's current document validation process (Figure 2) in the ExtendSim[4] software tool. For the time estimates at each step, we used the limited data sample provided. The time estimates at each step were implemented as a random triangular distribution with the minimum, average, and maximum values calculated from the data where possible. Where there was no data, we used the service's provided time boxes. After constructing the models, we validated them with the respective service's gatekeeper and updated them according to their comments.

SIMULATION OF THE CURRENT PROCESS

We ran the model 1,000 times and recorded every time a project's ICD or CDD was approved. The distributions of ICD and CDD times are shown in Appendix A, and resulted in average times of 516 days and 336 days for ICD and CDDs approvals, respectively. In the current process, the ICD comes first, then an acquisition community Analysis of Alternatives (AoA), and then the CDD follows as a next iteration. Omitting the time to execute the AoA, according to the model, the combined time to review and approve both an ICD and CDD averaged an estimated total of 852 days in the current process.

A limitation of this result lies in not knowing the acquisition category of each document. We had to assume we were modeling the average document. Further, we did not have enough data points to confidently conclude that we had a normal distribution. With these caveats, the model was presented to the Navy Gatekeeper, who confirmed the model's validity both in terms of the structure as well as the simulation's output. The validation of the as-is model provided the basis for an exploration of process alternatives that may reduce latencies.

SIMULATION OF PROCESS ALTERNATIVES

We developed two alternatives to the current process in conjunction with subject matter experts. The new processes promise to reduce JCIDS latencies while maintaining the core functions of the process, such as validation of a requirement and consideration for joint interoperability. In general, these new processes eliminate redundant reviews and streamline documentation requirements.

- **Process Alternative 1 -- Integrated Capabilities Development Document**

The first proposed process streamlines the documentation of JCIDS by integrating the ICD into the CDD by replacing it with an Initial CDD (I-CDD). Currently, the CDD and ICD are two separate documents with two different formats. To create an ICD, requirement sponsors must do much of the same work that goes into a CDD. Since the documents are in different formats, requirement sponsors have to take time to duplicate the ICD effort into the CDD.

In this new process alternative, the first part of the JCIDS process consists of the creation and validation of an I-CDD. This document describes high level capability requirements without getting too specific regarding Key Performance Parameters or materiel solutions. It goes through a traditional review such as is provided in the original process. Once the I-CDD is validated, an Analysis of Alternatives (AoA) may take place. Once the AoA is completed, the backend of the process may commence. The output of the AoA will inform the revision of the I-CDD. Requirement sponsors will update the document to reflect the desired requirements. The validation of this updated document, which is a CDD, is much leaner since most of the document has already been validated. The JROC only needs to be concerned with the updates to the document. Figure 5 illustrates the new process from Capability Based Assessment to validated CDD.

Simulated trials of the Integrated CDD process suggest reduced latencies in JCIDS. Using the same time distributions, we updated the baseline model to reflect the new flow. In 1,000 trials, the JCIDS process took an average of 444 days, a maximum of 630 days, and a minimum of 59 days, with a standard deviation of 274 days. The results are a clear improvement from the baseline process, and could be considered a worst-case scenario for the Integrated CDD process. For example, in its current form, the revision of the CDD follows the same time distribution as writing the I-CDD. However, it is reasonable to expect that the revision would take a shorter amount of time than writing the document from scratch. To be conservative in estimating benefits, we did not make that assumption.

[4] extendsim.com

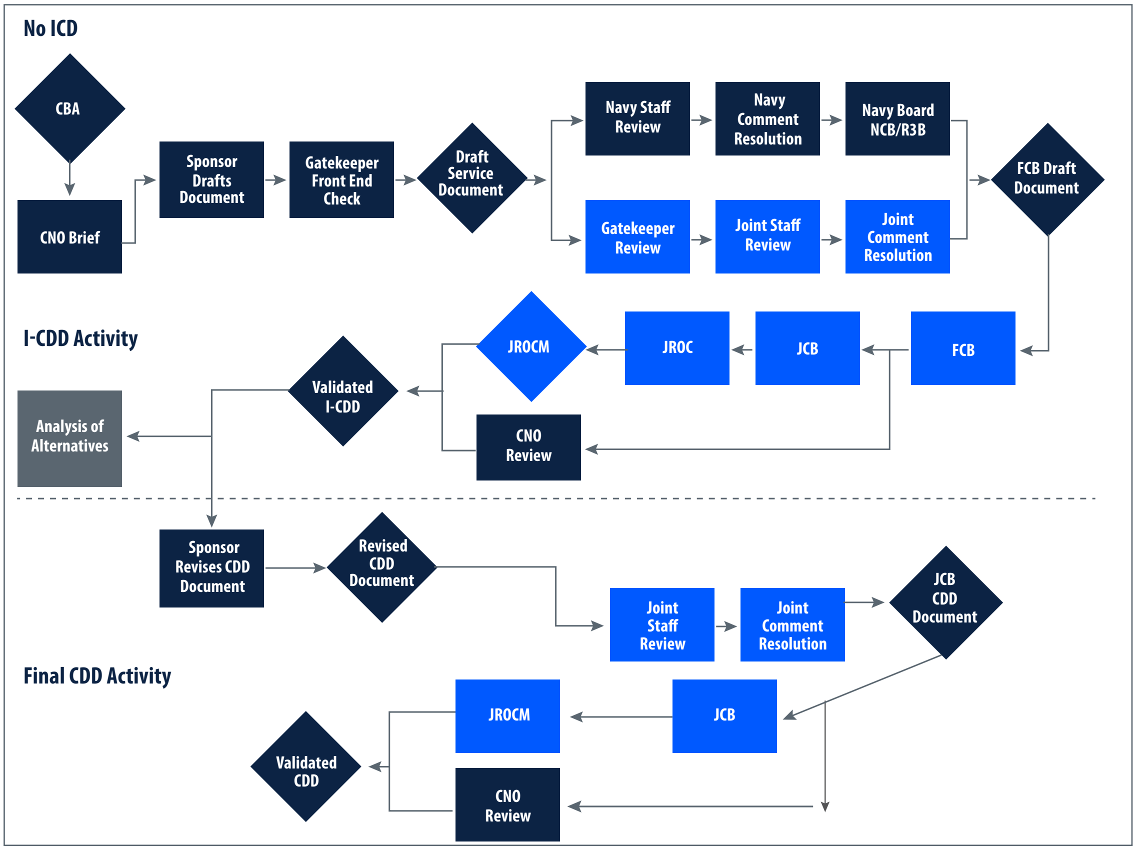

Figure 5. Flow chart of Integrated CDD process for validating a requirement.

- **Process Alternative 2 -- Special Operations Rapid Requirement Document**

A second process alternative that we explored is an adaptive requirements framework utilized by the United States Special Operations Command (USSOCOM). The current process does not distinguish between the different sizes of the requirements or priority of efforts. For example, the process for approving a new Air Force fighter jet is the same as approving a jungle boot. Senior Military commanders might consider that each size requirement document (Acquisition Category, or ACAT, I-IV) should not have the same approval process. Also, they may desire that a high priority effort have an expedited process. Recently, USSOCOM has developed a requirement document, called a Special Operations Rapid Requirement Document (SORRD), for expedient approval that aligns with the Middle Tier Acquisition (one of the six Adaptive Acquisition Framework pathways). The SORRD has a 96-hour limit to be submitted for approval via the Special Operations Command Requirements Evaluation Board (SOCREB), which takes 30 days to validate the requirement. It is reasonable that each service has the authority to validate an ACAT III size requirement document. Service specific and smaller acquisitions should have a streamlined requirement document that can be rapidly produced for approval. However, if the requirement document has multiple service use, that validated requirement is sent to the JCIDS Gatekeeper for dissemination across the joint community.

Given the SORRD's success in USSOCOM, we applied the same concept to the Navy's requirement approval process. We adapted the existing model according to instruction from subject matter experts on the SORRD process. The expedited frontend of the process leads to a validated SORRD document that enables the rapid prototyping of a solution. After the prototyping phase, the sponsor can continue with a CDD that results in a validated requirement. Figure 6 illustrates the new process.

The SORRD implementation of JCIDS requirement validation was successful in reducing process time. The mean for the SORRD process was 309 days, with a minimum of 185 days, a maximum of 451 days, and a standard deviation of 48 days. The reduction from over two years to under a year is a significant improvement. Under this new framework, capability documents will be validated faster, enabling quicker acquisition outcomes. There are fewer reviews in the new process, which indicates an increase in acquisition risk. These trade-offs must be considered when changing the existing JCIDS process. It is important to note that USSOCOM has not had any significant issues with the SORRD process in terms of interoperability failure.

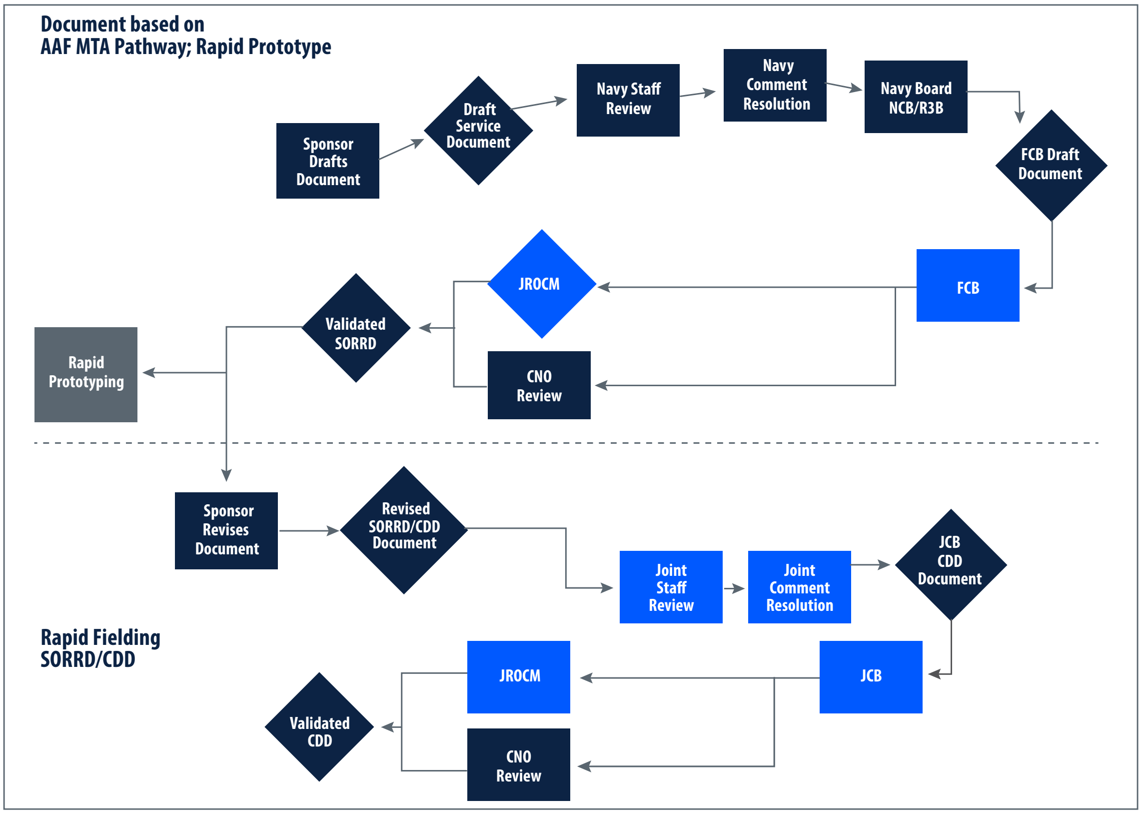

Figure 6. The proposed SORRD process for JCIDS.

SUMMARY OF QUANTITATIVE ASSESSMENT OF CHANGES

Table 1 summarizes the effects of changes considered by our VSM and simulation analyses on average JCIDS time. Further details, including plots of time distributions from the simulation runs, are provided in Appendix A.

JCIDS Process Improvements Considered	
CHANGE	**POTENTIAL EFFECT**
1. Make current process leaner	25% faster (or more)
2. Change process and documents • Integrated CDD • SORRD Rapid Requirements	 852 → 444 days 852 → 309 days

Table 1: Effects of JCIDS Changes Considered

QUALITATIVE RESEARCH

Our qualitative approach began with a literature review and a series of semi-structured interviews with subject matter experts. We collected data from a wide variety of perspectives of JCIDS, and requirements generation broadly; and we interviewed joint staff, service staff, academics, and private industry executives. The experts provided insight into problem definition and contextualized a possible solution. We took notes of each interview and sought thematic connections among them. Combined with our technical knowledge of the process, the interviews provided first-hand insights into the source of JCIDS latencies and strategies for overcoming those delays. While our task is concerned with streamlining the JCIDS process, in the course of our research we came upon significant governance issues within the system that we believe play a part in the system's issues. We identify some of those high-level governance problems, which may be explored in depth in future work.

We also assessed the industry best practices in writing and validating requirements. Since JCIDS, and the U.S. military more generally, is such a unique system, we drew on a wide variety of information sources, including the private sector and other national militaries, to craft a holistic picture of the state-of-the-art in systems engineering.

INTERVIEW INSIGHTS

The interviews with JCIDS stakeholders as well as external subject matter experts resulted in a series of qualitative insights that indicate the source of JCIDS latencies and recommendations for improvement. Much of the information drawn from this section points to issues regarding the governance of JCIDS: the governance structures are either non-existent or poorly designed. This failure of system design has resulted in a poorly incentivized system, causing delays in requirements validation. Following is a summary of insights, which are also visualized in Figure 7:

1. Personnel issues

The nature of the position of requirement officer has hindered the system's ability to write and validate requirements in a timely manner. There is constant personnel turnover, meaning there is a continuous need to train officers on the efforts within JCIDS. Documents are not comprehensively written, resulting in more adjudication on the backend. Even the simplest of formatting errors result in rework. There are also concerns whether the level of training that the Defense Acquisition University provides is sufficient to support the JCIDS mission.

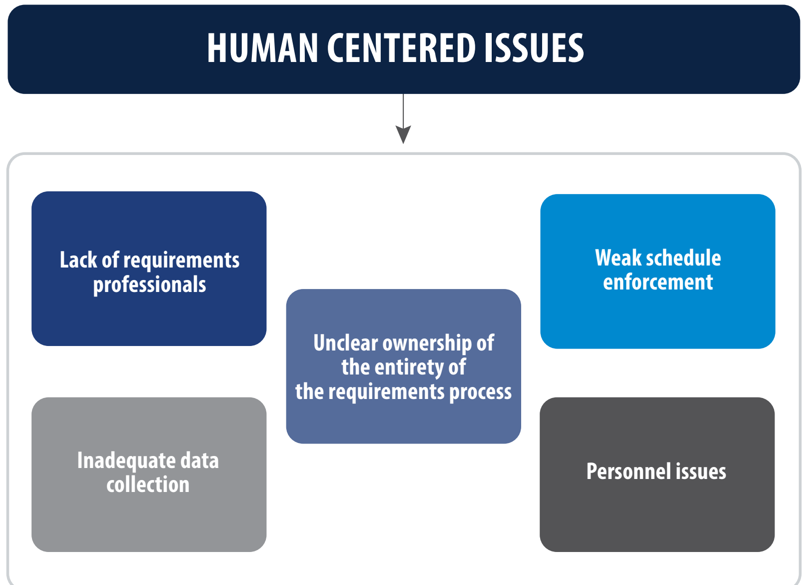

Figure 7. Human centered issues in JCIDS.

2. Unclear ownership of the entirety of the requirements process

There is not clear guidance on what organization is responsible for the entire requirements process in the "Big A" context. The JCIDS manual is produced by the Joint Staff J8 office, but the Services are responsible for portions of the execution within the process. A requirement begins when a user, who is typically a warfighter in the field, identifies a need. The user's service is responsible for delivering the requirement to the JCIDS staffing process and ultimately the JROC. Hence, both the Service and the JROC are tasked with validating the requirement. The lack of clarity regarding what organization is responsible for the requirement and its effect on "Big A" acquisition is an example of poor governance. Without a well-defined owner of the process, there is little incentive and even less directive authority to improve it.

3. Weak schedule enforcement

The weak schedule enforcement is evidenced by the latencies in the process. Time boxes do exist for each step in the process, but gratuitous delays persist. There are many mechanisms that are designed to maintain scheduling in similar systems. Electronic information systems are often useful tools in this context. Without an incentive for making schedules or disincentives for missing deadlines, JCIDS stakeholders will continue to miss deadlines.

4. Inadequate data collection

As described in the Government Accountability Office 2021 report "Joint Staff Lacks Reliable Data on the Effectiveness of Its Revised Joint Approval Process," there are shortfalls in the collection of data for the JCIDS process. Data is crucial for analyzing the process retroactively: it enables stakeholders to assess their practices and make recommendations for the future. An automated workflow system could improve the JCIDS authoring and comment process, enable better schedule discipline, and capture data to make the identification of process constraints much easier. An agile JCIDS will constantly optimize the process and minimize latencies.

5. Lack of requirements professionals

A major point of concern among interviewed stakeholders was the lack of a certified professional requirement community. Both the DAS and the PPBES pillars have dedicated professionals to acquire and fund DoD validated requirements. Stakeholders in JCIDS are a combination of officers and enlisted personnel who are serving a short-term duty assignment. There is not a concerted focus on the creation of high-quality requirement documents, which is not an easy task, and requirement sponsors are not equipped nor trained to write documents effectively. Most often, the creation of requirement documents is an additional duty for requirement sponsors who have other tasks. Further, JCIDS Gatekeepers are process oriented rather than knowledgeable of proper requirement document construction. The combination of an under qualified document writer along with a Gatekeeper concerned with semantics is an unfortunate mix that results in process latencies. A professional requirement community would bring state-of-the-art rigor to the creation and validation of requirement documents.

BEST PRACTICES

Concurrently with our other qualitative efforts, we assessed industry best practices for developing requirements in both public and private organizations. We interviewed subject matter experts and reviewed the current literature to develop an understanding of these systems engineering activities. Finally, we synthesized our findings into a series of principles that aid in rapid requirements development and validation.

The U.S. military operates on a scale that dwarfs all other military departments globally. For this reason, we looked to organizations that operate on a similar, enormous scale. We determined that the automobile industry was a reasonable simulacrum for U.S. military acquisition: it engages in rapid capability development on a large scale. Many of the automobile industry's systems engineering practices are informative in the context of JCIDS. We interviewed executives in the automobile industry as well as reviewed the literature on requirements engineering in the industry. Our findings are summarized as follows:

1. Capability selection

It is important for automobile manufacturers to select and develop the right capabilities that fit the market. Firms typically have a risk preference that is suitable for the selected capability and are organizationally structured to develop the capability. For incremental improvements to the product line, the preference is for low risk, and uncertainty bands for cost, schedule, and performance are tight. For the introduction of significant new technologies, such as electric vehicles, the risks and uncertainties are considerably higher. The engineering organization structure supports collaboration to develop new capabilities at the preferred level of risk exposure and empowers the Chief Engineer to resolve issues and make final decisions.

2. Conflict resolution

Automotive design teams structure their processes to enable the efficient resolution of stakeholder conflict. Notably, an engineering manager is the ultimate decision authority for conflicting requirements. The automotive model for conflict resolution reflects the risk tolerance of an enterprise and places responsibility on fewer individuals. In contrast, JCIDS requirement conflicts go through a prolonged process of commenting and resolution via world-wide staffing until a compromise is reached.

Despite the value that insights from the automobile industry provide for improving JCIDS, there are some key differences between the organizations that warrant further research into best practices. First, the automobile manufacturing industry is market driven. The success of a project is easily quantifiable by its success in the market. The U.S. military does not have the same ability in assessing their acquisitions. Because of this key difference between the private sector and military acquisition, we looked to other military acquisition systems to further assess best practices. We used a similar methodology that included interviewing experts and reviewing the literature. The main points are as follows:

1. Adaptive requirement approval

Different acquisition levels should have different levels of approval. ACAT II, III, and IV size programs should be afforded a streamlined process for requirement validation. Expensive or high-risk projects may need to continue to follow the current deliberate JCIDS process.

2. Agile principles

Acquisition organizations are increasingly adopting agile development processes in the definition of requirements. This includes the institution of collaborative design, cross-functional teams, and digital transformation to facilitate as such. Practices like daily (or weekly) stand-ups are appealing because they ingrain collaboration into the process and could promote requirement sponsor and acquisition team dialogue. Currently, there is no prescribed collaboration, but rather collaborative design is dependent upon the discretion of the requirement sponsor.

3. High-level requirements focus

Writing requirements at a high level allows for implementation flexibility. Requirements that are too specific both pigeonhole the ultimate acquisition system as well as result in a lot of conflict among stakeholders in validating the requirements.

RECOMMENDATIONS

Both our quantitative and qualitative work indicate that there are several steps that can be taken to improve JCIDS, and lead us to make the following recommendations (visualized in Figures 8 and 9) for the improvement of JCIDS with a focus on reducing latencies:

- **Adopt an Agile JCIDS Framework:** Revise the current JCIDS documentation and staffing process to adapt to the nature of the requirement. For requirements expected to result in ACAT I size solutions, adopt the Integrated CDD process that eliminates steps by making the CDD an update to the I-CDD. For other requirements, make the SORRD process the preferred process, coupled with the Middle Tier Acquisition. If needed, pilot this process in each Service first and then update the JCIDS process accordingly.
- **Streamline the JCIDS staffing process:** Establish a team of stakeholders to apply Value Stream Mapping to staffing steps that remain in JCIDS under the preceding recommendation. Charter the team to "walk the process" on several JCIDS examples, collect data, and streamline process steps using the methodology of McManus (2005). Revise the JCIDS manual and Service counterparts based on this analysis.
- **Enforce JCIDS schedules:** Establish and track suspense dates for steps in the JCIDS process in both JS and Service task assignment systems to give JCIDS documents the same high priority that other important documents receive. Capture data from these systems to simplify the analysis of JCIDS and eliminate process constraints.
- **Clarify end-to-end governance of the requirements process:** JCIDS is the culmination of the overall requirements process, which is a critical input to "Big A" acquisition. The requirements process starts with a warfighter need in the field, which precedes JCIDS staffing. Update the JCIDS manual to include the frontend Service and COCOM responsibilities for gap analysis and initial document drafting and provide for early collaboration among the key stakeholders to address joint issues.
- **Review additional ideas for applicability to JCIDS in the Big A context:**
  - **Professionalize the requirements community:** The DoD has developed career paths and training/education programs for professionals in acquisition management (1101 Series) and resource management. Given the importance of requirements development, establishing a cadre of professional requirement developers could address shortcomings we found in the current JCIDS process, where the requirement sponsor role is typically a relatively short assignment for a military officer with no background in requirements definition. Expertise as a professional warfighter is important, but needs to be supported with expertise in systems engineering, concept of operations, system of system architectures, and life cycle sustainment processes. As Model Based Engineering matures within DoD, expertise in modeling and simulation for requirement development will take on additional importance. Civilian specialists could provide the needed support to military requirement sponsors. Research is required to identify the needed knowledge, skills, and abilities for a requirement professional; to assess the training and education needs and career progression paths for such professionals; and to quantify the number of professionals needed across DoD. Planning for a professional requirements workforce requires assessing alternatives for assigning current DoD employees, hiring new employees,

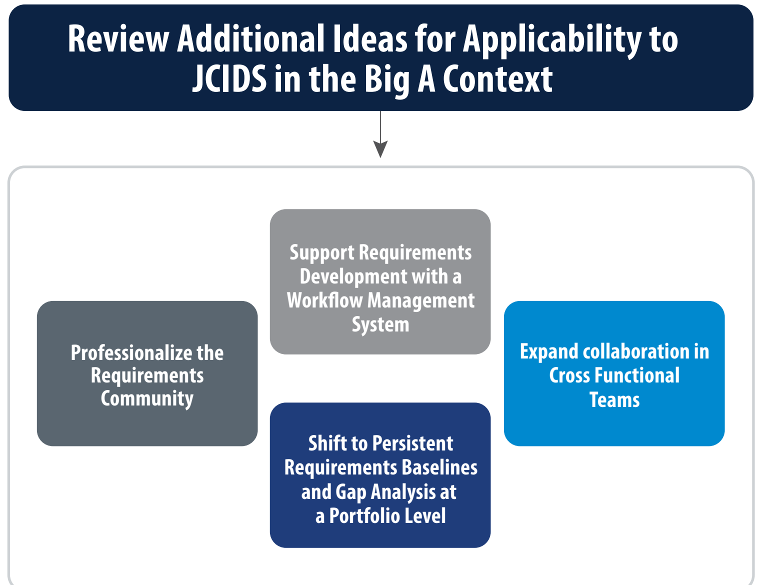

Figure 8. Additional ideas for exploration regarding improving JCIDS.

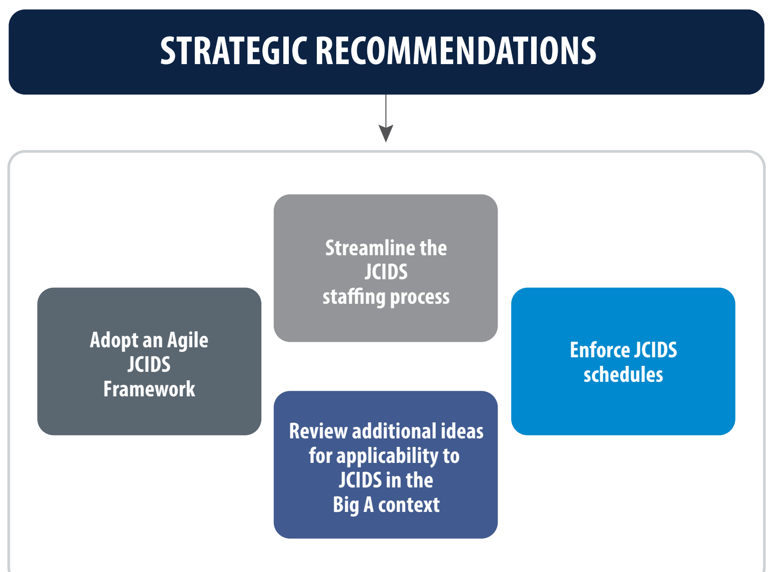

Figure 9. Strategic recommendations for improving JCIDS.

or expanding contractor support. The goal of research in this area would be a plan for establishing this new element of the DoD "Big A" workforce based on a foundation of best practices in other fields and an assessment of the costs and benefits.

- **Shift to persistent requirements baselines and gap analysis at a portfolio level:** Similar to the MITRE recommendation on Warfighter Essential Requirements (Modigliani et al., 2020), we find that many overarching Service and Joint requirements are enduring in nature and amenable to incremental improvements, rather than the current JCIDS approach. The system of systems nature of modern warfare suggests the need for mission engineering and warfare integration architectures, which are cutting edge research topics in the systems engineering community. Management of requirement portfolios, whether by Service organizations such as the Navy Warfare Integration office or Joint Functional Control Boards, will increasingly need support from professional requirement specialists. Further research in these areas is needed to identify candidate requirement portfolios and appropriate governance mechanisms in the Services and Joint Staff.

- **Expand collaboration in cross functional teams:** JCIDS maintains a clear policy separation between requirement sponsors and solution providers, and cost agnostic definition of requirements. Best practice in market driven sectors, such as the automobile industry, involves much greater collaboration between requirement developers and engineers. The DoD is not market driven, but the Army's Cross Functional Team (CFT) approach appears to be a way to adopt collaboration best practices within a military mission area context. Further investigation of private sector practices and Army CFT experience offers a path to improve "Big A" collaboration in JCIDS without compromising the role of the JROC.

- **Support requirement development with a workflow management system:** The JCIDS process, either as is or modified (as recommended in this report), merits investment in a modern workflow management system with built-in artificial intelligence assistance – a "TurboTax for JCIDS." Our research did not extend to evaluation of such systems, but the poor schedule discipline evident in the JCIDS data indicates the need for such a system. Research in this area would result in recommended specifications for a system that would result in better JCIDS documentation content, less rework, smoother stakeholder comment and adjudication cycles, better data capture, and overall time savings.

CONCLUSION

Ultimately, the findings of this report culminate in recommendations for better governance, streamlined documents and staffing, and digital transformation that will improve the timeliness of JCIDS requirement validation. The recommendations comprise a first step in streamlining the requirement process for more responsive acquisitions that align with Congress's request defined in FY2021 NDAA, Section 809. We appreciate the support this study received from the Joint and Navy JCIDS Gatekeepers, but strong and sustained support from senior leaders in the DoD acquisition and requirements communities will be needed to bring about the needed changes.

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APPENDIX A

ANALYTICAL APPROACH AND SUPPORTING DETAILS

1. Exploratory Analysis of the Data

We started our modeling activity with an exploratory analysis of the data. Since we are concerned with the differences in the Services and how they engage with JCIDS, most of our analyses separate the services. First, we looked at the time spent at each stage of the requirements generation process. Figure A-1 illustrates the percentage of time spent at each stage of the JCIDS process for the Navy.

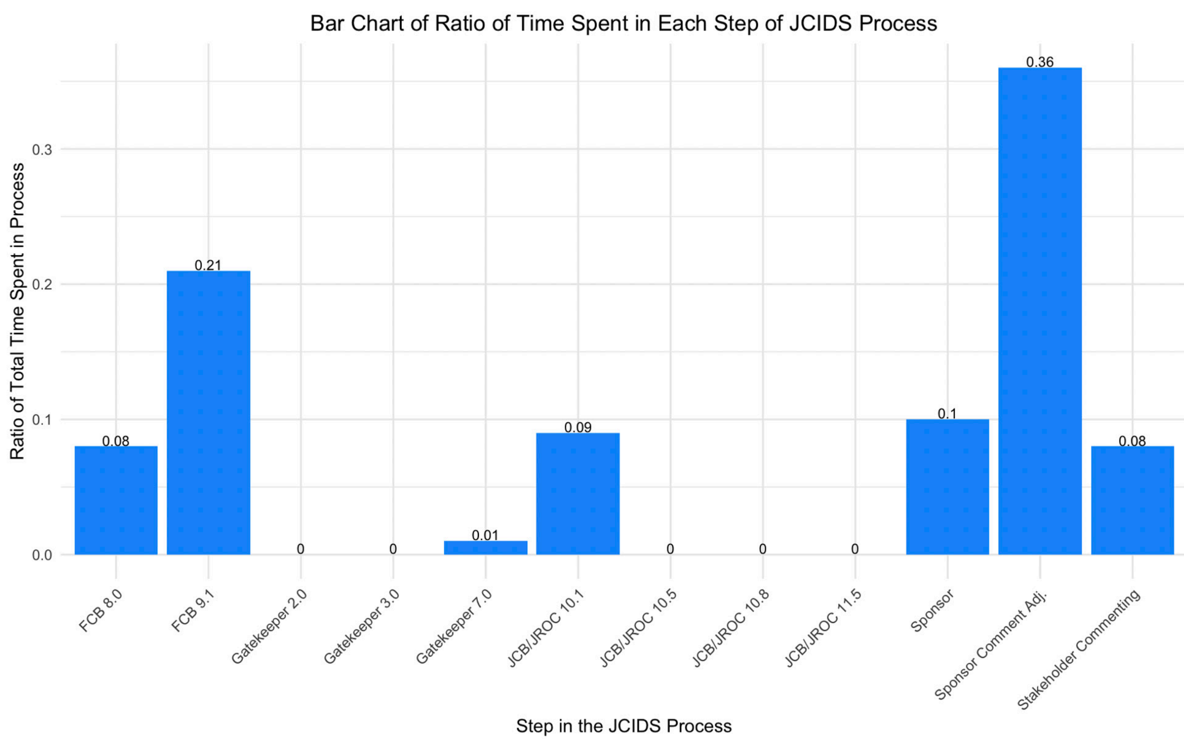

Figure A-1: The percentage of time spent at each stage in the JCIDS process (Navy).

The most time-consuming stages were Sponsor Comment Adjudication and FCB 9.1. For the Navy, Sponsor Comment Adjudication took 36% of the total time and FCB 9.1 took 21% of the total time.

Next, we looked at the total time spent for each document, disaggregated by the type of document. Figure A-2 plots each document by its start date and time until JCB/JROC approval.

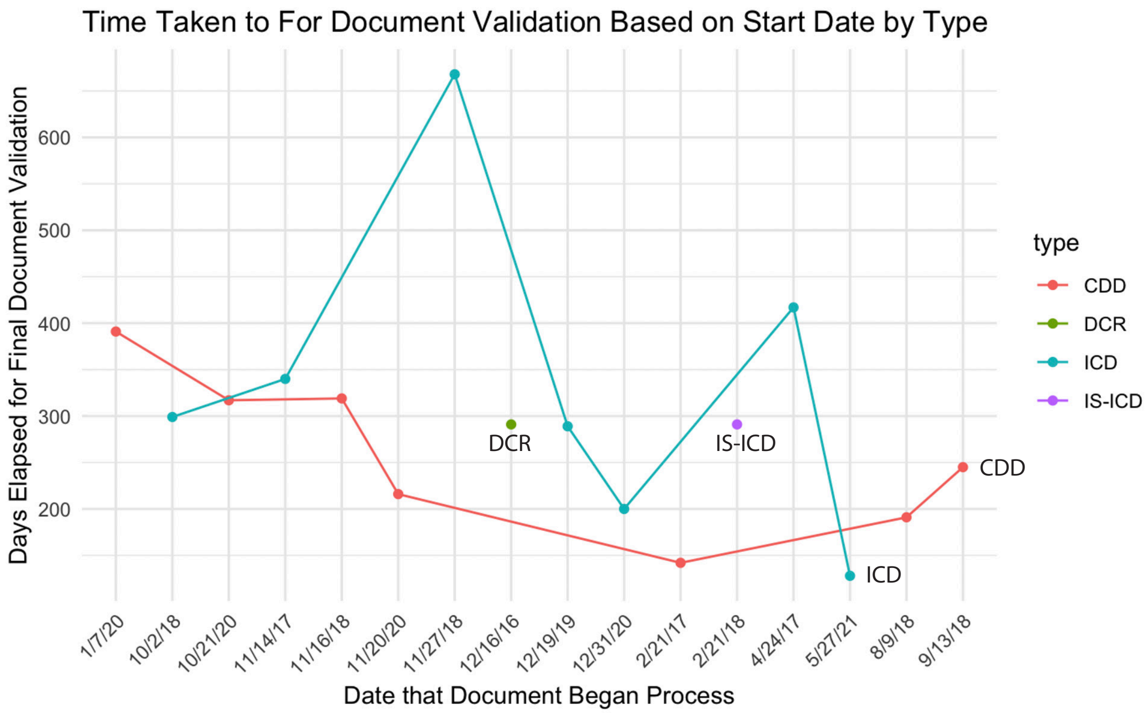

Figure A-2. Time series distribution with data split by document type (Navy).

The graph does not reveal any meaningful trend over time. The different document types are not clearly grouped into any strata of the distribution, nor is there an interaction with the start date of the document. Therefore, there is not a document type that takes longer than the others.

Next, we conducted a similar analysis, but did not disaggregate the documents based on type. Figure A-3 shows such a time series plot for the Navy.

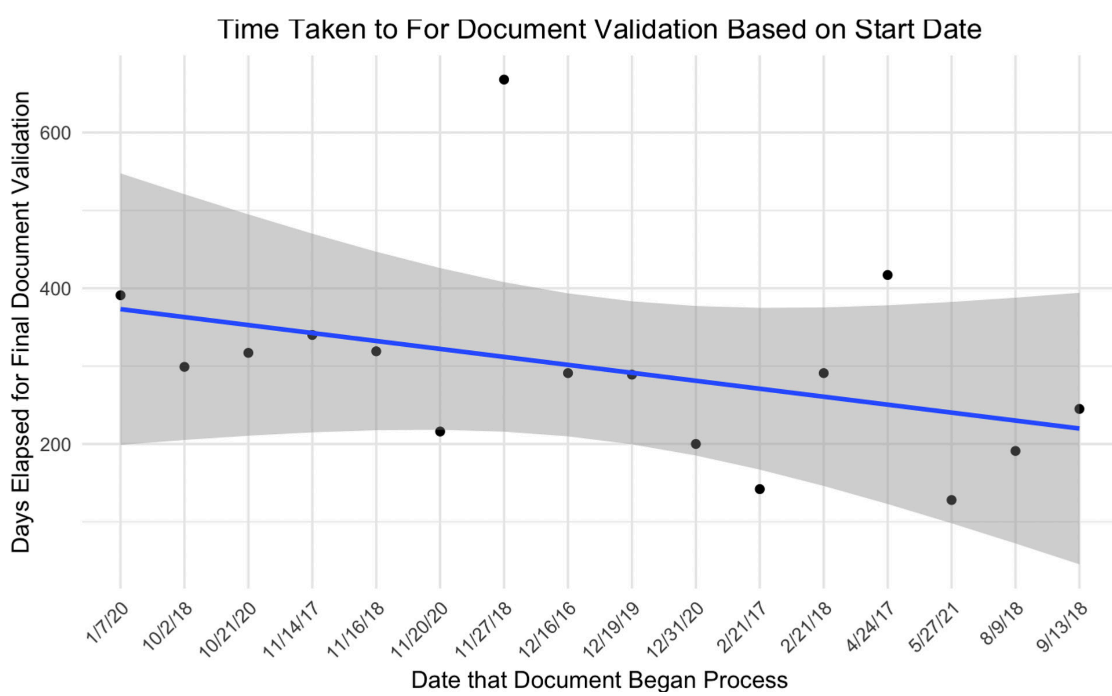

Figure A-3: Pooled time series distribution for Navy JCIDS process.

This analysis attempts to illustrate whether the start date of a document has an impact on the total time the document takes until JCB/JROC approval. A significant result would indicate a particular trend in JCIDS efficiency. The R^2 value of 0.022 indicates that the start date is responsible for about 2% of the variation in the total time to approval for the Navy. This relatively small percentage indicates that JCIDS has not been trending in any direction since 2016, and we must look to other variables as sources of latency.

2. Value Stream Mapping Analysis

For the purposes of illustrating the VSM method, Figure 4 (page 8) in our report shows the cycle times (CTs) from our data sample where available and uses the Navy's target times as in process times (IPTs). In a real application of VSM, actual IPTs would be documented by a team of stakeholders observing the active work time ("touch time") for each step. These IPTs would be considerably shorter than those shown in Figure 4 and would establish a lower bound on the total time for the current process. The difference between CT and IPT becomes a target for reduction, typically by reducing wait time. To further illustrate this point, Table A-1 includes our subject estimates of reasonable IPTs, allowing for meeting scheduling and comment cycles in a large organization like the DoD. Table A-1 also includes our conjectures about actual active work IPTs. In many cases, there are significant differences between the two. For example, the JCB review has a target time box of 14 days, but in reality is supposed to be one-day board meetings. The result is that a huge amount of wait time could be targeted for reduction or elimination – as much as 80% of the total JCIDS time. This reduction is done for urgent requirements that get top priority, but as a practical matter cannot be done for all documents. We therefore limited our observation to the conservative estimate that targeting wait time in the Joint Comment step alone could save over 100 days, a 25% reduction in JCIDS time.

Activity	Target Time	Actual Mean Cycle Time	Subjective Reasonable IPT	Conjecture Active IPT
Navy Staff Review	51	103	10	1
Gatekeeper	4	6	2	1
Joint Staff Review	21	23	10	1
Joint Comment	30	150	30	3
FCB	14	39	14	1
JCB	14	52	14	1

Table A-1. Target CT, Actual CT, Reasonable IPT, and Active Work IPT for Key Steps in the JCIDS Process

3. Discrete Event Simulation Modeling

Literature Search

To date, there have been a few key pieces of literature on quantitatively modeling the military acquisition process. Schwenn et al. present preliminary analysis on an agent-based simulation model of the acquisition process (2015). Methodologies like game theory (Pennock, 2008) and investment valuation (Pennock et al. 2007) have also been used to model acquisition as a whole. Bodner, Smith, and Rouse's work on acquisition modeling is notable in that it utilized a discrete event model and focuses on a specific aspect of acquisition: the modularity of particular acquisition projects (Bodner, Smith, & Rouse, 2009).

The most comprehensive work on simulated acquisition is the Enterprise Requirements and Acquisition Model (ERAM). This discrete event model was created by Wirthlin in 2009 as part of his dissertation at MIT (Wirthlin, 2009). It is a discrete event model that simulates acquisition projects from initial requirement definition, pre-milestone A (MS-A), through to MS-C. It logs data on time spent in the process as well as project costs. It has since been updated multiple times to reflect more recent iterations of the acquisition process, most recently in 2014.

ERAM is useful in that researchers can use it to identify issues in the process and try different intervention techniques to see how they would affect acquisition outcomes. For example, Colombi et al. utilize ERAM to explore how interventions concerning the Analysis of Alternatives, systems engineering activities, scope growth, and technological maturity can influence acquisition speed (Colombi & Wirthlin, 2014). They also added a space launch acquisition module to ERAM to investigate schedule growth in space launch projects, finding that technologically mature projects experience fewer threats to scheduling.

Our Simulation Model

Our discrete event modeling efforts began with the development of a discrete event model that represents the Navy's current document validation process. We took a methodical approach to its development. First, we requested charts from the Navy Gatekeeper that described their JCIDS process with time boxes at each step. Next, we recreated the processes in the ExtendSim software. For the time estimates at each step, we sourced actual acquisition projects data from the Knowledge Management/Decision Support (KM/DS) system. The data tracked a document's time at each step in the process from document writing to Joint Requirements Oversight Council (JROC) approval. The data is sparse and only identifies the type of document, not any other critical identifying information, like acquisition category, that could have captured more fully the richness of the data. At each step, we calculated the minimum, maximum, and average time a document spent there. The time estimates at each step are implemented as a random triangular distribution with the minimum, average, and maximum values calculated from the data where possible. Where there was no data, we used the service's provided time boxes. After constructing the models, we validated them with the respective service's gatekeeper and updated them according to their comments.

We ran the models 1,000 times for the As Is process and recorded every time a project's ICD or CDD was approved. Figures A-4, A-5, and A-6 show the outcomes.

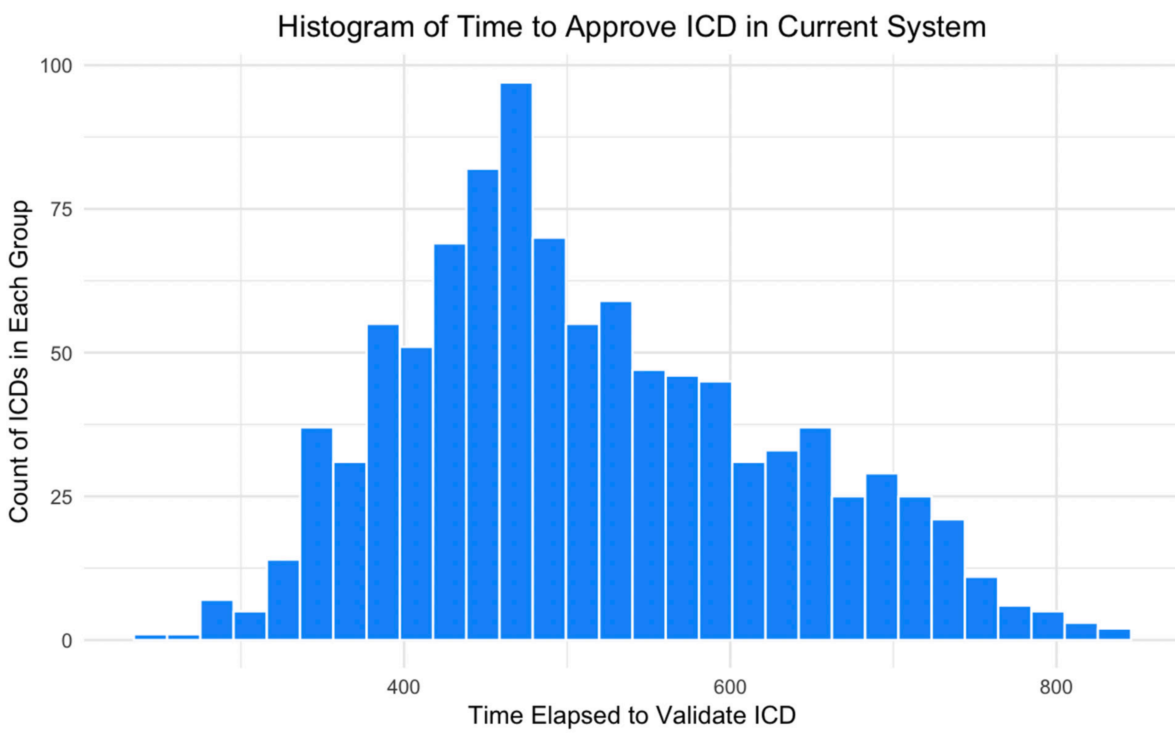

Figure A-4. Histogram of document time to ICD approval (Navy).

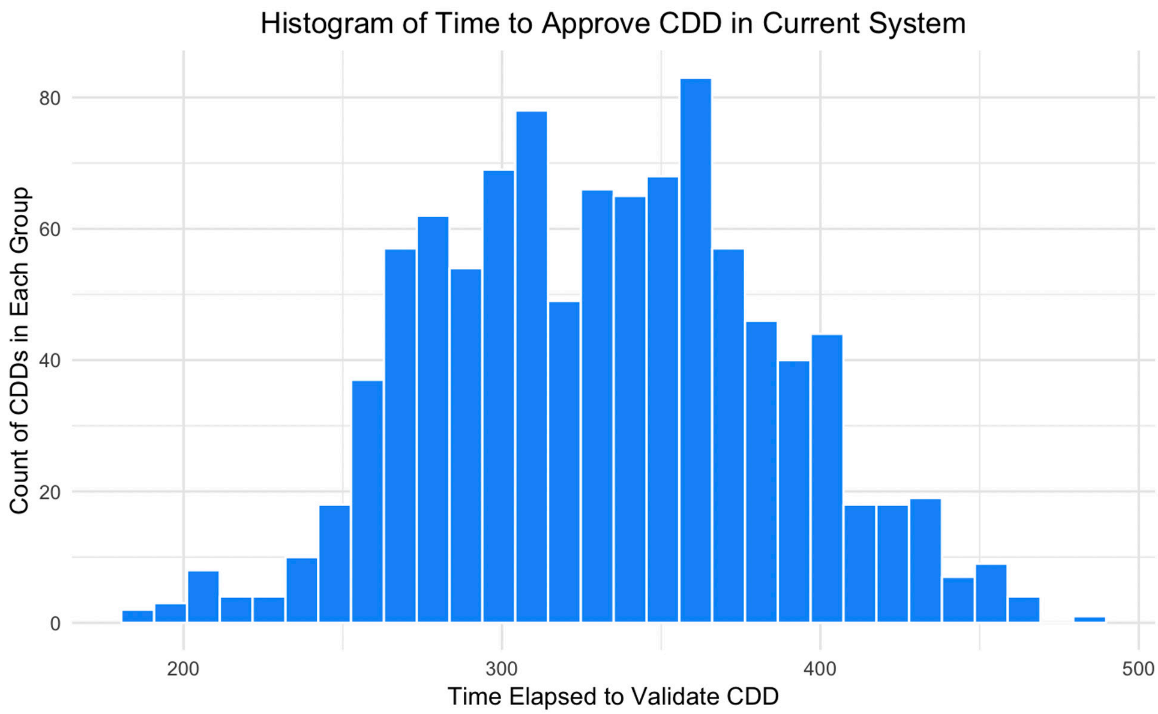

Figure A-5. Histogram of document time from ICD to CDD approval (Navy).

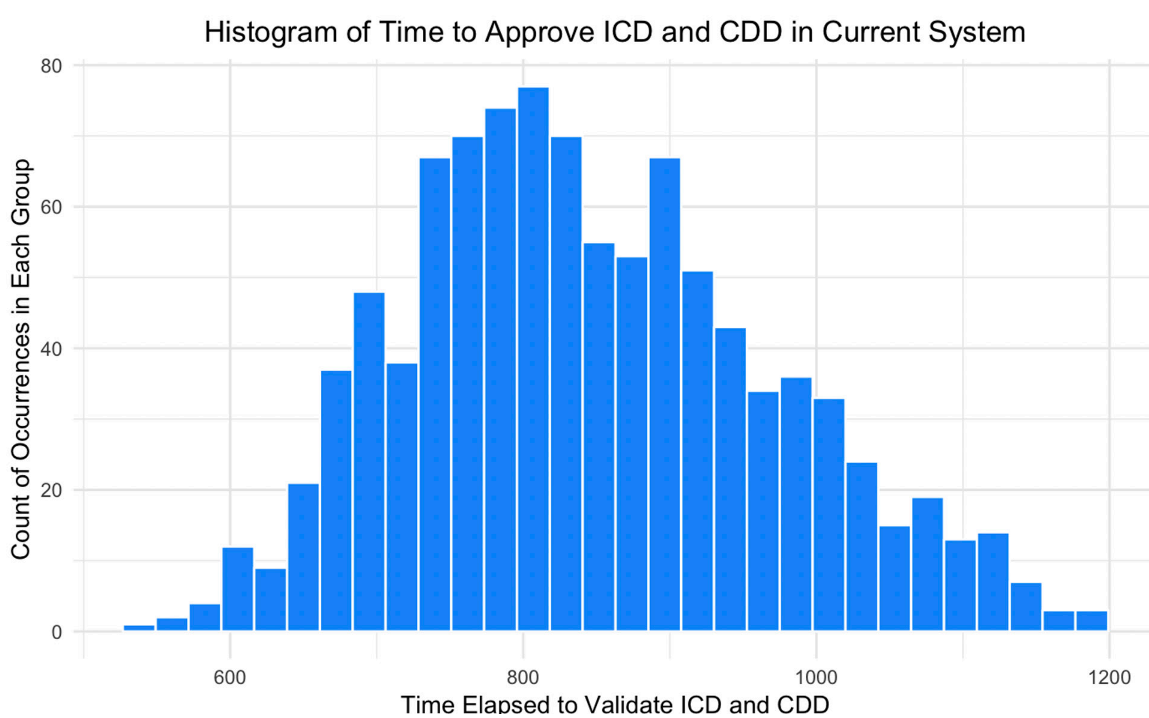

Figure A-6. Histogram of document time to CDD approval (Navy).

The Navy time to ICD approval spanned an average of 516 days, a maximum of 859 days, a minimum of 254 days, and a standard deviation of 111 days. The time from ICD to CDD approval spanned an average of 336 days, a maximum of 501 days, a minimum of 202 days, and a standard deviation of 53 days. Finally, the total time from beginning to CDD approval spanned an average of 852 days, a maximum of 1293 days, a minimum of 267 days, and a standard deviation of 123 days.

A limitation of this model lies in the assumptions made based on the provided data. For example, not knowing the acquisition category of each document meant we had to treat them all the same. So, even if most of the documents belong to a particular category, we had to assume we were modeling the average document. Further, we did not have enough data points to confidently conclude that we had a normal distribution. Yet, we acted as such for the sake of the model. Therefore, the distributions were possibly not reflective of the actual latencies within the JCIDS process, which may have led to the significant standard deviations in the output.

Simulating Process Alternatives

The process alternatives (Integrated ICD and SORRD) discussed in our report eliminate redundant reviews and streamlines documentation requirements. We used our simulation model to arrive at the estimates of reduction in average time to a validated requirement document: 442 days for I-CDD and 329 days for SORRD. The modeling provided the distributions shown in figures A-7 and A-8, allowing us to estimate minimum and maximum times and standard deviations.

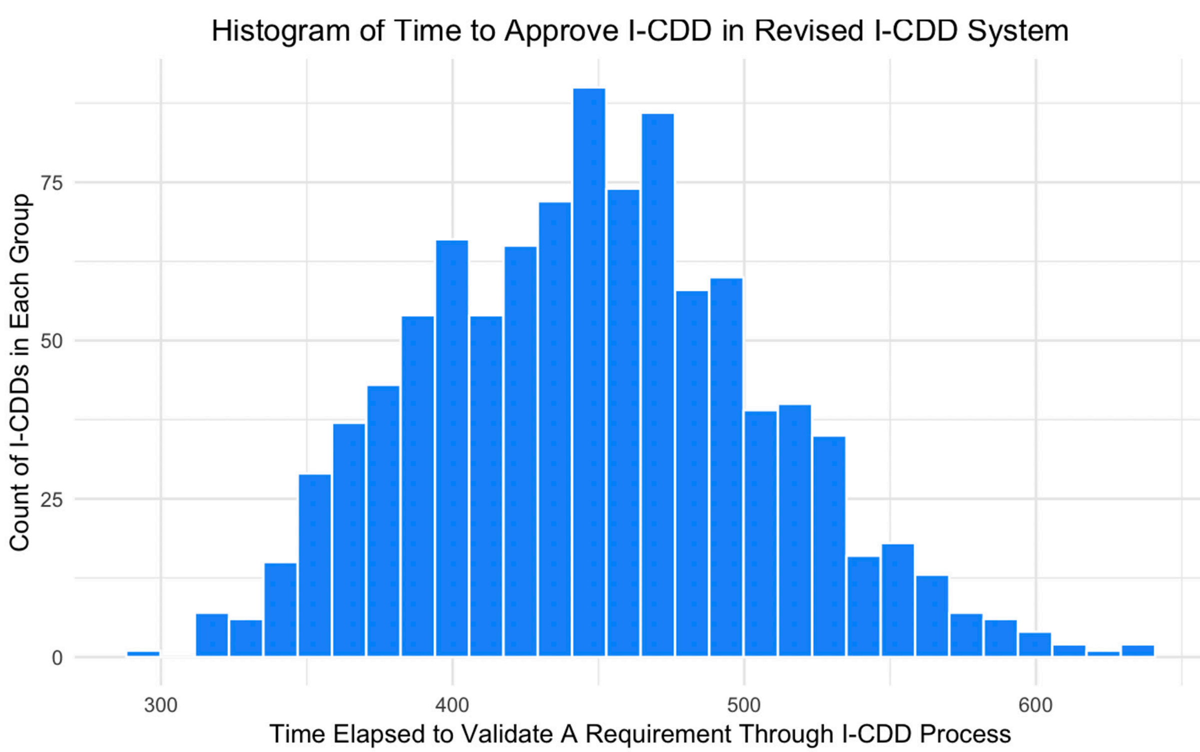

Figure A-7. Histogram of results of the simulated Integrated CDD process.

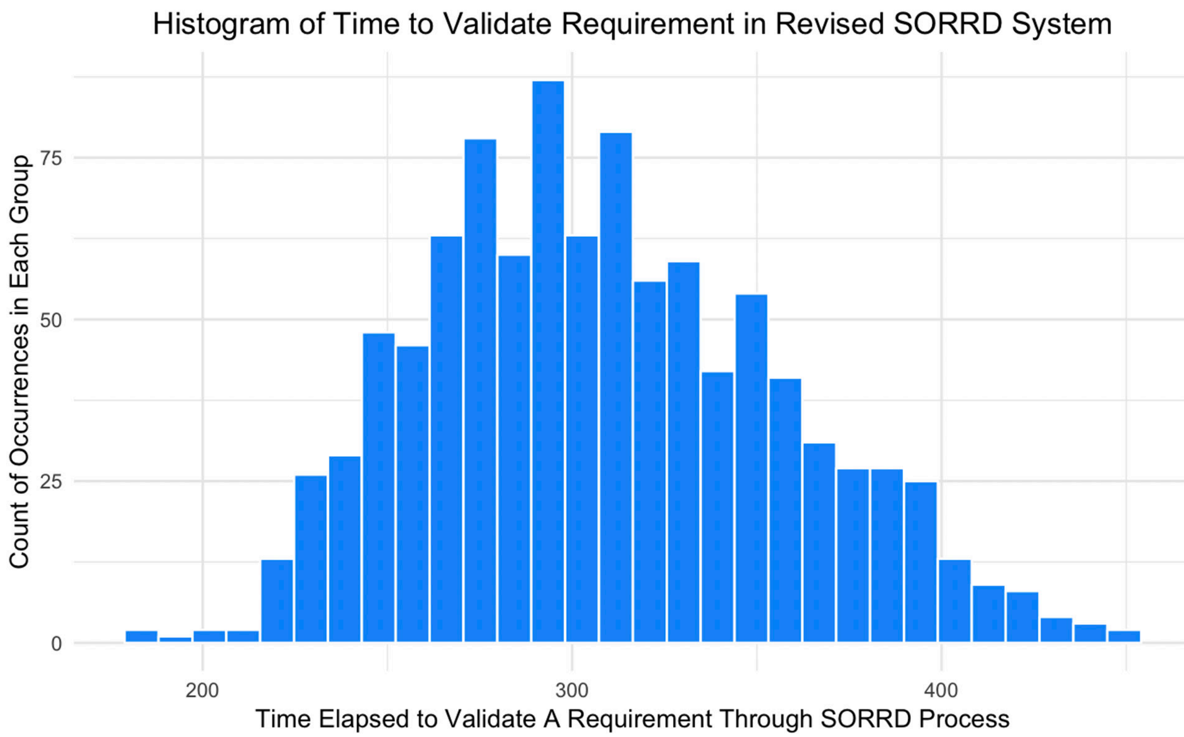

Figure A-8. Histogram of the results of the simulated SORRD process.

The Acquisition Innovation Research Center is a multi-university partnership led by the Stevens Institute of Technology and sponsored by the U.S. Department of Defense (DoD) as part of the System Engineering Research Center (SERC)—a DoD University Affiliated Research Center (UARC).

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