

Internship Abstract

While performing human factors tasks within the Exploration Medical Capabilities Element's (ExMC) systems engineering team, I focused on five projects:

1. IMPACT Run
2. IMPACT Tableau
3. IMPACT Design Guidelines
4. Foundation Long Duration Concept of Operations Icon Study
5. Systems Engineering SharePoint Redesign

IMPACT Description

As shown in figure 1, IMPACT is composed of several subsystems that work together to quantify the effects that a potential human health and performance capability could have on crew health outcomes. IMPACT informs decision making by providing quantitative answers to questions regarding medical capability on exploration missions. For example, a user can employ this system to discover what medical conditions are likely to occur on a specific mission to a particular crew. During the course of my internship, I focused on IMPACT Run and Tableau.

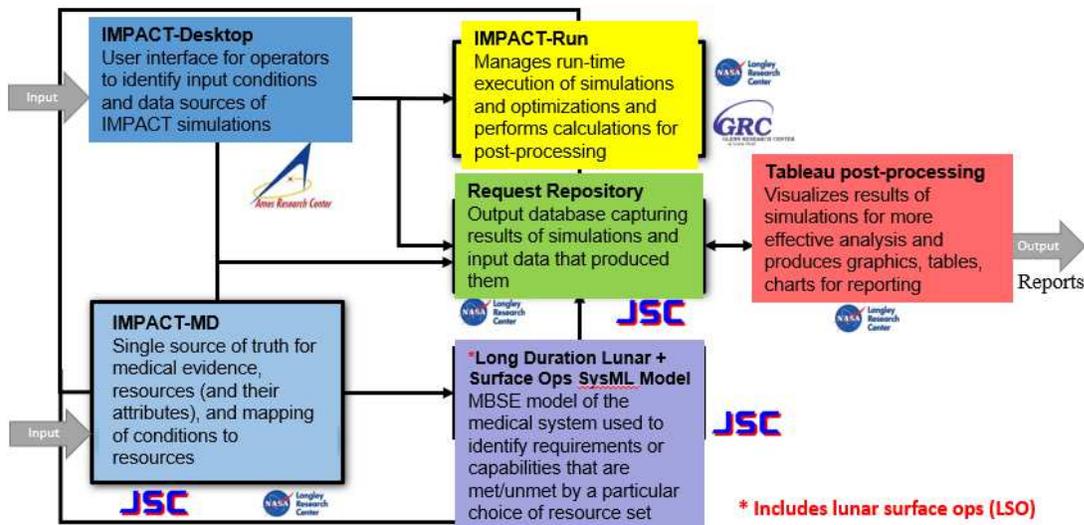


Figure 1: IMPACT Systems

IMPACT Run

Description

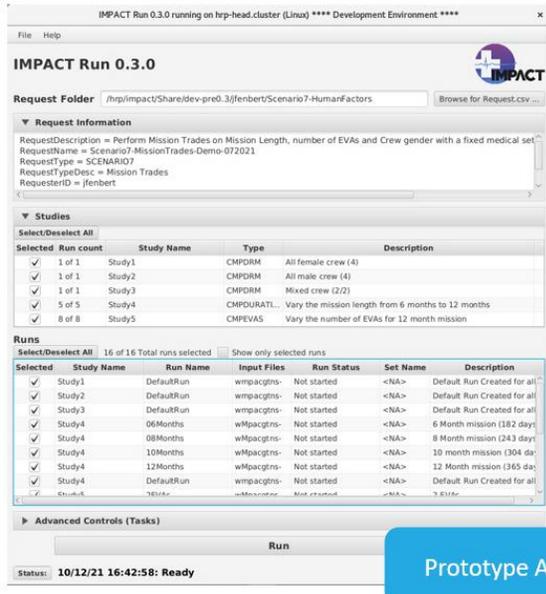
IMPACT Run is a subsystem of IMPACT where users select which studies and runs they would like the system to perform calculations on for later visualization use in Tableau. A study often consists of multiple runs, which are the specific conditions the user has previously inputted using IMPACT Desktop.

In this project, the human factor's team wanted to run an A/B test to determine usability among two different design concepts. I was tasked with designing concept B, helping create the test plan, scheduling participants, taking notes on the usability test, and analyzing the results in Excel. Figure 2 represents the designs I created, and Figure 3 shows the two functional prototypes that were tested.

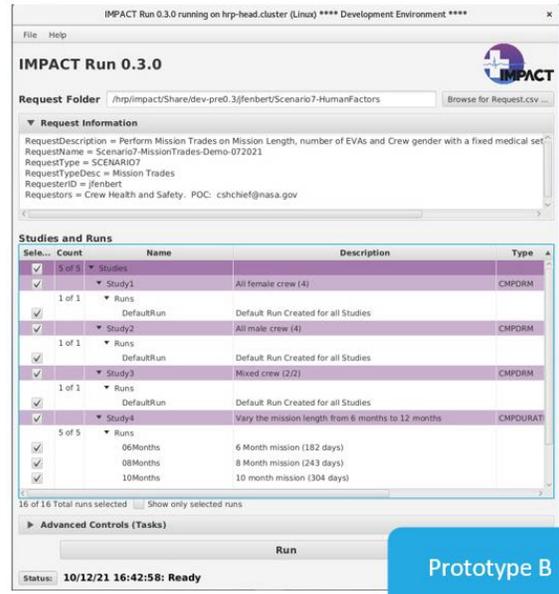
Study Name	Study Description	
AllFemale	All female crew (4)	Details
<input checked="" type="checkbox"/> AllMale	All male crew (4)	Details
Run Name	Run Description	
<input checked="" type="checkbox"/> DefaultRun	The Default run	
<input type="checkbox"/> Run2	The second run	
<input type="checkbox"/> Run3	The third run	
<input checked="" type="checkbox"/> Mixed	Mixed crew (2/2)	Details
<input type="checkbox"/> VaryMissionLength	Vary the mission length from 6 to 12 months	Details

Study Name	Study Description	
AllFemale	All female crew (4)	▼
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<input checked="" type="checkbox"/> DefaultRun	The Default run	
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<input type="checkbox"/> Run3	The third run	
<input checked="" type="checkbox"/> Mixed	Mixed crew (2/2)	▼
<input type="checkbox"/> VaryMissionLength	Vary the mission length from 6 to 12 months	▼

Figure 2: Design Concepts



Prototype A



Prototype B

Figure 3: Prototype A (original design) and B (new design)

Outcome

Overall, we discovered which areas of IMPACT Run were the most confusing to users, what design they liked the most, which features they wished were included, and how to make the software more user friendly. We presented our results to the development team, and suggestions will be implemented. Our A/B testing allowed developers to better understand user frustrations, know how to make the software better, and obtain ideas for new and useful features. Through this project, I gained valuable experience with setting up an A/B test, analyzing data, working with a development team, and designing with limitations. This experience will greatly help me when I must run an A/B test of my own in the future.

IMPACT Tableau

Description

Tableau is another subsystem of IMPACT. This software visualizes the results of selected studies and runs in the form of graphics, tables, and charts for further analysis. On the landing page (figure 4), users select which studies, runs, and visualization type they would like to view. Once a selection has been made, the software displays visual data and the user can make their analysis.

In this project, I assisted in the creation of a task analysis and the development of an A/B test plan. I was also tasked to design concept B for the landing page (figure 5) and filter bar (figure 6).

Day of Date	Requester Email	IMPACT Desktop User ID	IMPACT Run User ID	Request Type	Request Name	Study Name	Selected?
August 15, 2021	sdhar	sdhar	sdhar	Compare to Medical Kits	Cluster_Study	60kg_150L_NoSurg	<input type="checkbox"/>
						LD68_Baseline_40kg_150L_1_1	<input checked="" type="checkbox"/>
						LD68_Baseline_60kg_150L_1_1	<input checked="" type="checkbox"/>
						LD73_Clustered_40kg_150L_1_1	<input checked="" type="checkbox"/>
						LD73_Clustered_60kg_150L_1_1	<input checked="" type="checkbox"/>
					LD68_60kg_150L_EVA	60kg_150L_1_1_EVA_0	<input checked="" type="checkbox"/>
						60kg_150L_1_1_EVA_10	<input checked="" type="checkbox"/>
						60kg_150L_1_1_EVA_12	<input checked="" type="checkbox"/>
						60kg_150L_1_1_EVA_14	<input checked="" type="checkbox"/>
						60kg_150L_1_1_EVA_4	<input checked="" type="checkbox"/>
						60kg_150L_1_1_EVA_6	<input checked="" type="checkbox"/>
						60kg_150L_1_1_EVA_8	<input checked="" type="checkbox"/>
					LD68_AbdomSurg4	60kg_150L_1_1_AltSurg	<input checked="" type="checkbox"/>

Visualization Type	Selected The Relevant Visualization Type	
Comparison - Categorical X Axis	Cluster_Study_LD68_60kg_150L_EVA4, LD68_AbdomSurg4, LD68_AbdomSurg5	<input type="checkbox"/>
Conditions Influencing Risks	Cluster_Study_LD68_60kg_150L_EVA4, LD68_AbdomSurg4, LD68_AbdomSurg5	<input checked="" type="checkbox"/>
Exhausted Resources and Impacted Conditions	Cluster_Study_LD68_60kg_150L_EVA4, LD68_AbdomSurg4, LD68_AbdomSurg5	<input checked="" type="checkbox"/>
Medical Set Content	Cluster_Study_LD68_60kg_150L_EVA4, LD68_AbdomSurg4, LD68_AbdomSurg5	<input type="checkbox"/>
Resource Figures of Merit	Cluster_Study_LD68_60kg_150L_EVA4, LD68_AbdomSurg4, LD68_AbdomSurg5	<input type="checkbox"/>

Figure 4: Original Landing Page Design

Date Created	Requester Email	IMPACT Desktop User ID	IMPACT Run User ID	Request Type	Request Name	Study Name	Selected?
August 15th, 2021	sdhar	sdhar	sdhar	Compare to Medical Kits	Cluster_Study	LD68_Baseline_40kg_150L_1_1	<input type="checkbox"/>
						LD68_Baseline_60kg_150L_1_1	<input checked="" type="checkbox"/>
						LD73_Clustered_40kg_150L_1_1	<input checked="" type="checkbox"/>
						LD73_Clustered_60kg_150L_1_1	<input type="checkbox"/>
	sdhar	sdhar	sdhar	Compare to Medical Kits	Cluster_Study	LD68_Baseline_40kg_150L_1_1	<input type="checkbox"/>
						LD68_Baseline_60kg_150L_1_1	<input checked="" type="checkbox"/>
						LD73_Clustered_40kg_150L_1_1	<input checked="" type="checkbox"/>
						LD73_Clustered_60kg_150L_1_1	<input type="checkbox"/>

Activities-Crew-Option Cluster_Study LD68_60kg_150L_EVA4 LD68_AbdomSurg4 LD68_AbdomSurg5 <input type="button" value="VIEW"/>	Amount for Resource X for Condition Y Cluster_Study LD68_60kg_150L_EVA4 LD68_AbdomSurg4 LD68_AbdomSurg5 <input type="button" value="VIEW"/>	Comparison - Categorical X Axis Cluster_Study LD68_60kg_150L_EVA4 LD68_AbdomSurg4 LD68_AbdomSurg5 <input type="button" value="VIEW"/>	Conditions Influencing Risks Cluster_Study LD68_60kg_150L_EVA4 LD68_AbdomSurg4 LD68_AbdomSurg5 <input type="button" value="VIEW"/>	Exhausted Resources and Impacted Conditions Cluster_Study LD68_60kg_150L_EVA4 LD68_AbdomSurg4 LD68_AbdomSurg5 <input type="button" value="VIEW"/>	Medical Set Content Cluster_Study LD68_60kg_150L_EVA4 LD68_AbdomSurg4 LD68_AbdomSurg5 <input type="button" value="VIEW"/>	Resource Figures of Merit Cluster_Study LD68_60kg_150L_EVA4 LD68_AbdomSurg4 LD68_AbdomSurg5 <input type="button" value="VIEW"/>
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Figure 5: Landing Page Concept Design

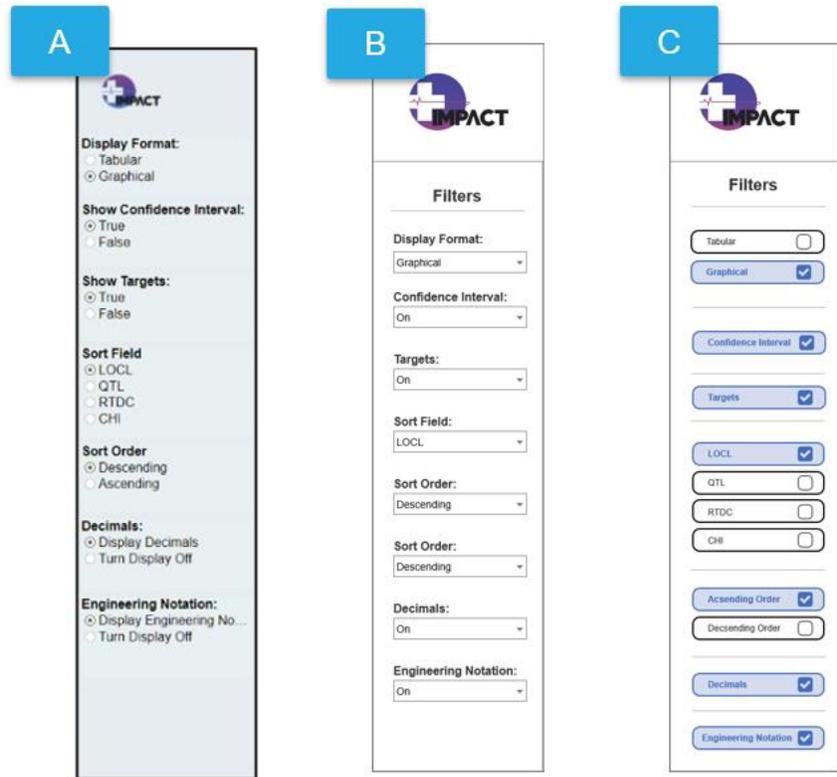


Figure 6: Filter Bar Designs (A is original)

Outcome

A/B testing has yet to be completed, but the test plan is ready to go, the developer was able to create a functional prototype of the design, and the participant list has been determined. Through this project, I gained valuable experience with creating a test plan, user interface design, and working with a developer.

IMPACT Design Guidelines

Description

Design guidelines are important user interface requirements that help keep a project's design consistent and unified. Since IMPACT did not already have a document like this, I started one. Design documents like this take a while to complete, but I believe I provided a foundation to be added to, as I was able to finish the color guidelines and start the guidelines on iconography. For color, I developed a primary color palette (figure 7), primary shades, a neutral palette for

background colors, and a semantic palette for success, warning, and error colors. I checked these colors through a color blindness simulator to ensure accessibility. I also defined color theory terms, provided use cases, and created visual examples of how each color can be used.

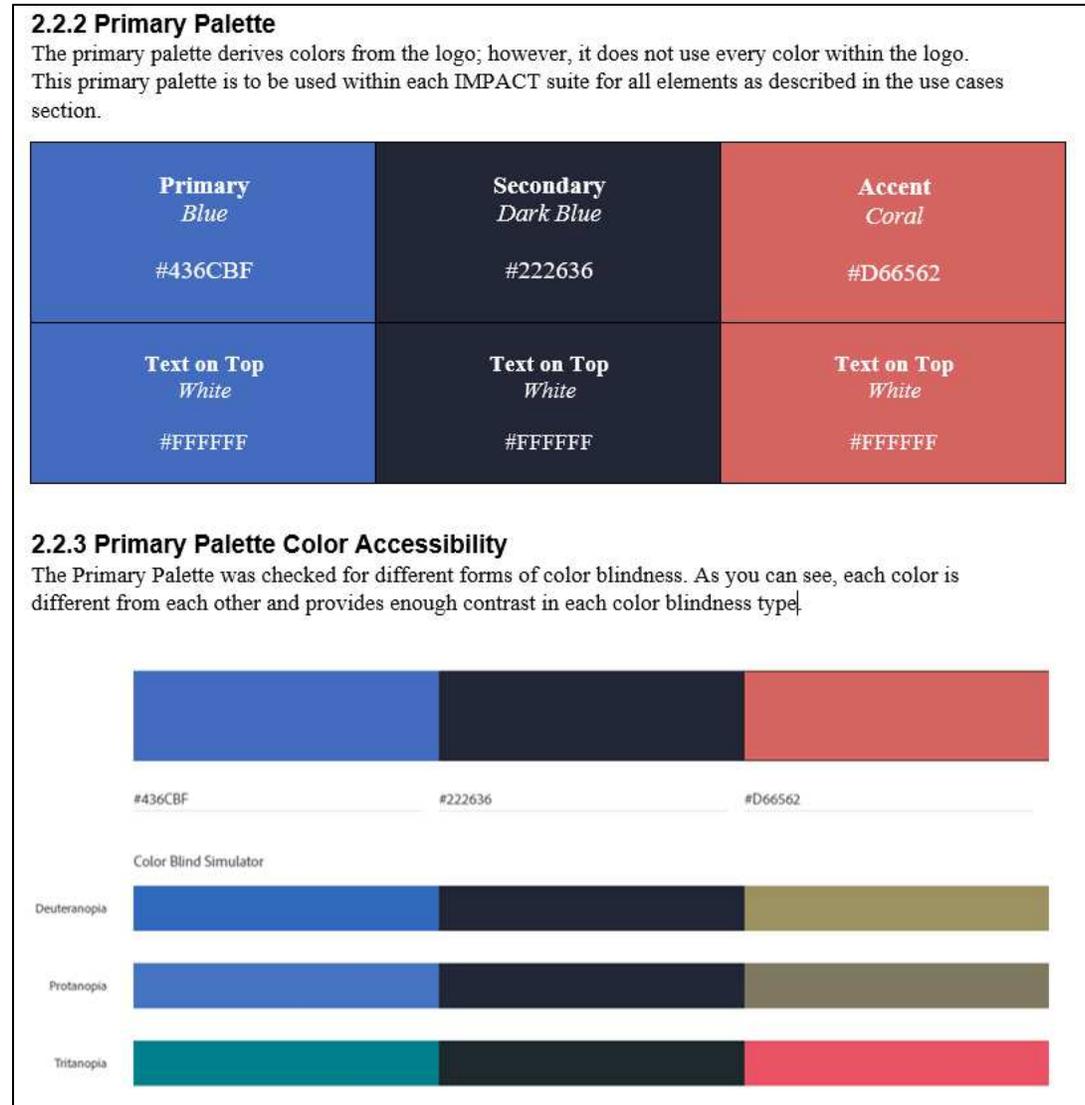


Figure 7: Primary Color Palette

Outcome

This document resulted in written down color guidelines for all IMPACT software. Use of these guidelines will improve visual consistency across all IMPACT software. Consistency is important for IMPACT because there are many different subsystems. According to NASA’s Human Integration Design Processes, consistent interfaces are easier to learn, to train, improve

reaction time and multi-tasking, and decrease error rates (Boyer, 2014). This document started with color, but additions can be made for other UI elements for the project. Through this project, I gained valuable experience in starting a design system document. This knowledge will greatly assist me with my future career, as most projects/companies use a design system.

Foundation Long Duration Concept of Operations Model Description

The Foundation Long Duration Concept of Operations is a model that provides information about medical care needs that will be used to guide the development of a medical system for the cis-lunar orbital and lunar surface operations. This medical system will serve as the precursor to the system that is implemented in future exploration missions to Mars. The concept of operations documents an overview of the stakeholder needs and system goals of a medical system and provides examples of the types of activities for which the system will be used during the mission.

Foundation Concept of Operations Icon Study

Description

In this project, I was tasked with developing an icon study to determine user preference on icons used within the functions and environments section of the Long Duration Foundation Concept of Operation Document. I created a test plan, scheduled participants, analyzed user feedback, and started to define user personas. In my test plan (figure 8), I included out of context icon testing, in-context icon ranking, and interview questions.

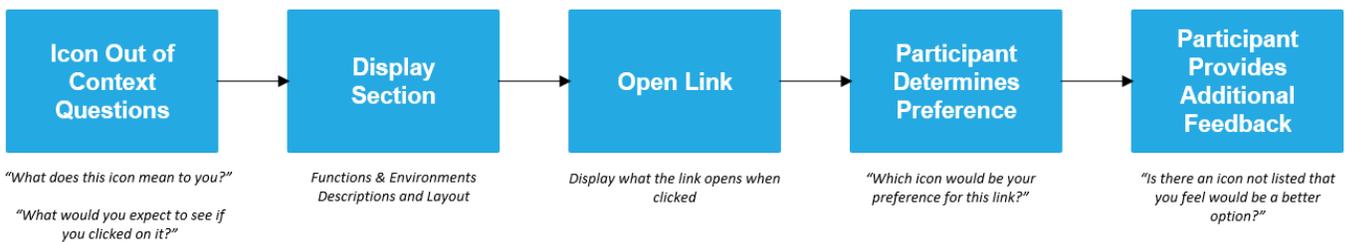


Figure 8: Study Design

Outcome

Due to time constraints and participant availability, I was only able to test a couple of users and determine preliminary results. In the future, more users will need to be tested, so I created a continuity document for the next person to easily pick up the study. This document includes my test plan, testing script, usability notes, potential participants, points of contact, and advice for next steps. The purpose of this continuity document is to provide useful information so that the next person to continue my work has an in-depth understanding of what I did and how to move forward. This project will be very beneficial when I am creating other studies in the future. For example, I now have more knowledge in identifying sampling criteria, determining sample size, creating interview scripts, verification and validation of interview questions, and data collection methods.

Systems Engineering SharePoint Redesign

Description

The current systems engineering SharePoint has information that is not used by the team, can take excess amount of time to find content, and is missing content that would be useful to team members when performing tasks. Also, the systems engineering team is conscience of their digital footprint and regularly identifies how to reduce the digital space they are using on servers. In this project, I worked with another intern to develop a site map, propose content changes, determine SharePoint goals, reduce the site's digital space, mockup design ideas, talked to a SharePoint developer about feasibility, and created a continuity document.

Outcome

We were able to discuss with the systems engineering team about our ideas and concerns to determine next steps and goals for the SharePoint. However, discussion is not over, so we have created a continuity document and next steps that the team can use when they are ready to change the SharePoint design. We decided to move toward a tile format (to be aligned with the design of other HRP sites) design, use an external server to store archived documents and use simple icons throughout the design. This project taught me a lot about content organization and

will help me in the future when redesigning interfaces that hold a lot of content and has users with a diverse set of needs.

References

Boyer, J. (2014, September). *Human Integration Design Processes (HIDP)*.

<https://ntrs.nasa.gov/api/citations/20140009559/downloads/20140009559.pdf>